SEC Petition Evaluation Report

Petition SEC-00251

Report Rev Number:	0
Report Submittal Date:	November 27, 2018
Subject Expert(s):	Joseph Guido, Pat McCloskey
Site Expert(s):	N/A

Petition Administrative Summary

Petition Under Evaluation

Petition Number:	SEC-00251
Petition Type:	83.14
Petition A Receipt Date:	November 9, 2018
DOE/AWE Facility Name:	Y-12 Plant

Petition Class

NIOSH-Proposed Class Definition:	All employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the Y-12 Plant in Oak Ridge, Tennessee, during the period January 1, 1958 through December 31, 1976 for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort.

Related Petition Summary Information

SEC Petition Tracking Number(s):	SEC-00018 SEC-00028 SEC-00098 SEC-00186
Petition Type:	83.13 83.13 83.14 83.14
DOE/AWE Facility Name:	Y-12 Plant Y-12 Plant Y-12 Plant Y-12 Plant
Petition Status:	Class added to the SEC for March 1943 through December 1947 Class added to the SEC for January 1948 through December 1957 Class added to the SEC for March 1, 1943 through December 31, 1947 Class added to the SEC for January 1, 1948 through December 31, 1957

Related Evaluation Report Information

Report Title:	SEC Petition Evaluation Report for Petition SEC-00018 SEC Petition Evaluation Report for Petition SEC-00028 SEC Petition Evaluation Report for Petition SEC-00098 SEC Petition Evaluation Report for Petition SEC-00186
DOE/AWE Facility Name:	Y-12 Plant Y-12 Plant Y-12 Plant Y-12 Plant

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Evaluation Report Summary: SEC-00251, Y-12 Plant

The National Institute for Occupational Safety and Health (NIOSH) prepared this evaluation report in response to a petition to add a class of workers at the Y-12 Plant to the Special Exposure Cohort (SEC). The *Energy Employees Occupational Illness Compensation Program Act of 2000*, as amended, (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*, describe the process for adding new classes to the SEC.

NIOSH-Proposed Class Definition

All employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the Y-12 Plant in Oak Ridge, Tennessee, during the period January 1, 1958 through December 31, 1976 for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort.

Feasibility of Dose Reconstruction Findings

NIOSH lacks sufficient information, which includes biological monitoring, air monitoring information, or process monitoring information, to allow it to estimate with sufficient accuracy the potential internal exposures to thorium (including associated progeny) or plutonium-241 to which the proposed class may have been subjected. NIOSH finds that it is likely feasible to reconstruct external and occupational medical dose for Y-12 employees with sufficient accuracy.

The NIOSH dose reconstruction feasibility findings are based on the following:

- Principal sources of internal radiation for members of the proposed class included exposures to thorium (including associated progeny) and plutonium-241. Exposures were from inhalation and ingestion during processing operations.

- Although NIOSH has determined that there appear to be sufficient *in-vivo* monitoring data for thorium (i.e., lung counts) during the period from January 1, 1959 through December 31, 1976, these data are recorded in total thorium mass. As such, NIOSH lacks the ability to use these data to determine the associated quantities of thorium-232, thorium-228, and radium-228 with sufficient accuracy. For this reason, NIOSH cannot determine with sufficient accuracy the internal exposures that might be represented by each thorium lung measurement.

- NIOSH has not identified biological monitoring data specific to plutonium-241 that can be used to reconstruct plutonium-241 exposure during the period from January 1, 1958 through December 31, 1966. NIOSH has identified sufficient monitoring data beginning in 1967 (i.e., the first sample was collected on January 29, 1967).

- Principal sources of external radiation for members of the proposed class included exposures to beta particles, gamma photons, and neutrons. The radiation sources potentially contributing to these exposures would have included processing operations related to thorium (and progeny) and plutonium-241.

- Beta, photon, and neutron monitoring data are available for Y-12 in the form of individual dosimetry records.

- Consistent with its findings in prior Y-12 evaluation reports, NIOSH finds that it is able to reconstruct external and medical X-ray dose for all Y-12 employees during the proposed time period.

- Pursuant to 42 C.F.R. § 83.13(c)(1), NIOSH determined that there is insufficient information to either: (1) estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the radiation doses of members of the class more precisely than a maximum dose estimate.

Although NIOSH found that it is not possible to completely reconstruct radiation doses for the proposed class, NIOSH intends to use any internal and external monitoring data that may become available for an individual claim (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures). Therefore, dose reconstructions for individuals employed at Y-12 during the period from January 1, 1958 through December 31, 1976, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

Health Endangerment Determination

NIOSH is aware of a nuclear criticality accident in Building 9212 of the Y-12 Plant on June 16, 1958. NIOSH has investigated the accident and has developed a roster of workers involved. NIOSH assigns radiation dose for the 1958 incident in accordance with ORAUT-OTIB-0057. This NIOSH evaluation did not identify any evidence that would establish that any additional members of the class were exposed to radiation during the 1958 incident or during any other discrete incident likely to have involved exceptionally high-level exposures, such as nuclear criticality incidents or other events involving similarly high levels of exposures. However, the evidence reviewed in this evaluation indicates that some employees in the class may have accumulated chronic radiation exposures through intakes of thorium (and associated progeny) and plutonium-241. Therefore, for the members of the class being evaluated herein, 42 C.F.R. § 83.13(c) (3) (ii) requires NIOSH to specify that health may have been endangered for those employees covered by this evaluation who were employed for a number of work days aggregating at least 250 work days within the parameters established for this class or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

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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: Joseph Guido, MJW Corporation. 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 employees who worked at Y-12 during a specified time (January 1, 1958 through December 31 1976). It provides information and analysis germane to considering a petition for adding a class of employees to the Congressionally-created SEC. NIOSH is continuing to evaluate the period beginning January 1, 1977 to determine if thorium-related infeasibility issues continued beyond the recommended SEC class period of 1958-1976.

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, with the exception of the employee whose dose reconstruction could not be completed, and whose claim consequently led to this petition evaluation. The finding in this report is not the final determination as to whether or not the proposed class will be added to the SEC. This report will be considered by the Advisory Board on Radiation and Worker Health (the Board) and by the Secretary of Health and Human Services (HHS). The Secretary of HHS will make final decisions concerning whether or not to add one or more classes to the SEC in response to the petition addressed by this report.

This evaluation, in which NIOSH provides its findings both on the feasibility of estimating radiation doses of members of this class with sufficient accuracy and on health endangerment, was conducted in accordance with the requirements of EEOICPA and 42 C.F.R. § 83.14.

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 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 proposed class of employees through NIOSH dose reconstructions.[1]

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 petitioners and the Advisory Board on Radiation and Worker Health. The Board will consider the NIOSH evaluation report, together with the petition, comments of the petitioner(s) and such other information as the

[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 on the NIOSH Radiation Dose Reconstruction Program page.

Board considers appropriate, 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 final decision process, the petitioner(s) may seek a review of certain types of final decisions issued by the Secretary of HHS.[2]

3.0 NIOSH-Proposed Class Definition and Petition Basis

The NIOSH-proposed class includes all employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the Y-12 Plant in Oak Ridge, Tennessee, during the period from January 1, 1958 through December 31, 1976 for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort. During this period, employees at this facility were involved in (1) thorium melting by arc and induction furnace and its subsequent formation into component parts and shapes; and (2) the separation and enrichment of plutonium in the plutonium-241 isotope.

The evaluation responds to Petition SEC-00251 which was submitted by an EEOICPA claimant whose dose reconstruction could not be completed by NIOSH due to a lack of sufficient dosimetry-related information. NIOSH's determination that it is unable to complete a dose reconstruction for an EEOICPA claimant is a qualified basis for submitting an SEC petition pursuant to 42 C.F.R. § 83.9(b).

4.0 Radiological Operations Relevant to the Proposed Class

This section summarizes the radiological operations at the Y-12 Plant from January 1, 1958 through December 31, 1976 and the information available to NIOSH to characterize particular processes and radioactive source materials. Using available sources, NIOSH has attempted to gather process and source descriptions, information regarding the identity and quantities of radionuclides of concern, and information describing processes through which the radiation exposures of concern may have occurred and the physical environment in which they may have occurred. The information included within this evaluation report is meant only to be a summary of the available information.

NIOSH is continuing to evaluate the period beginning January 1, 1977 to determine if thorium-related infeasibility issues continued beyond the recommended SEC class period of 1958-1976.

[2] See 42 C.F.R. pt. 83 for a full description of the procedures summarized here. Additional internal procedures are available on the NIOSH Radiation Dose Reconstruction Program page.

4.1 Operations Description

The Y-12 Plant is located in Oak Ridge, Tennessee on an 811-acre (0.67 miles wide and 3.2 miles long) site. At its peak, Y-12 employed approximately 22,000 workers (ORAUT-TKBS-0014-2). The following subsections summarize the radiological operations at the Y-12 Plant from January 1, 1958 through December 31, 1976.

4.1.1 Thorium Operations

Y-12's involvement in the production of thorium metal shapes began as a pilot program in 1959. It was a continuation of work that had previously been performed at the Bureau of Mines in Albany, Oregon. Bureau of Mines operations included arc melting, forging, rolling, and forming of thorium (Hibbs, 1961). Y-12 completed its initial order in October 1959. Table 4-1 lists the Y-12 buildings involved in these initial thorium activities.

Table 4-1: Y-12 Buildings Involved in Initial Thorium Operations

Building No.	Thorium Operation(s)
9202	Arc melting Double hammer forging Machining to final dimensions Annealing
9766	Machining
9215	Cold rolling Drawing to shape (hydroforming)

Source: Hibbs, 1960; Hibbs, 1961; Thorium Machining, 1960)

Thorium activities were expanded in the 1960s with facilities dedicated to these operations constructed in Building 9201-5 and 9204-2E (Personal Communication, 2018e). Y-12 contracted with other companies for thorium pellets and then pressed the metal into electrodes; subsequently, two arc meltings were performed.

In consumable-electrode arc-melting, the material to be cast serves as one electrode of an electric arc gap, and the heat of the arc melts the electrode. The opposite electrode is in a water-cooled crucible in which the molten metal solidifies. The consumable electrode is gradually lowered to maintain the proper arc gap, resulting in the melting of the consumable electrode and the casting of an ingot in the water-cooled crucible. Volatile impurities tend to move toward the cold walls of the crucible where they may be removed by light machining of the ingot (Cofield, 1961).

After arc melting, which removed most of the impurities, the thorium metal was then pressed, rolled, and formed or machined. The metal scraps were salvaged and also pressed into electrodes for the arc melting process. Figure 4-1 provides a summary of the Y-12 thorium production-scale activities.

An interview with a former worker indicated that the major activities involving thorium continued through the mid-1970s, after which the demand for thorium components diminished (Personal Communication, 2018e). Another interview indicated that thorium work was still ongoing in 1974 when they were in process quality control (Personal Communication, 2018d). A February 25, 1975 document states:

> *The thorium monitoring program in the arc melt area has been discontinued and added back to monitor for uranium. No changes have been made in the thorium program in the chip and press areas at this time. Tentative plans call for elimination of these area programs around July after complete phase out and decontamination.* (Thorium Melt, 1969)

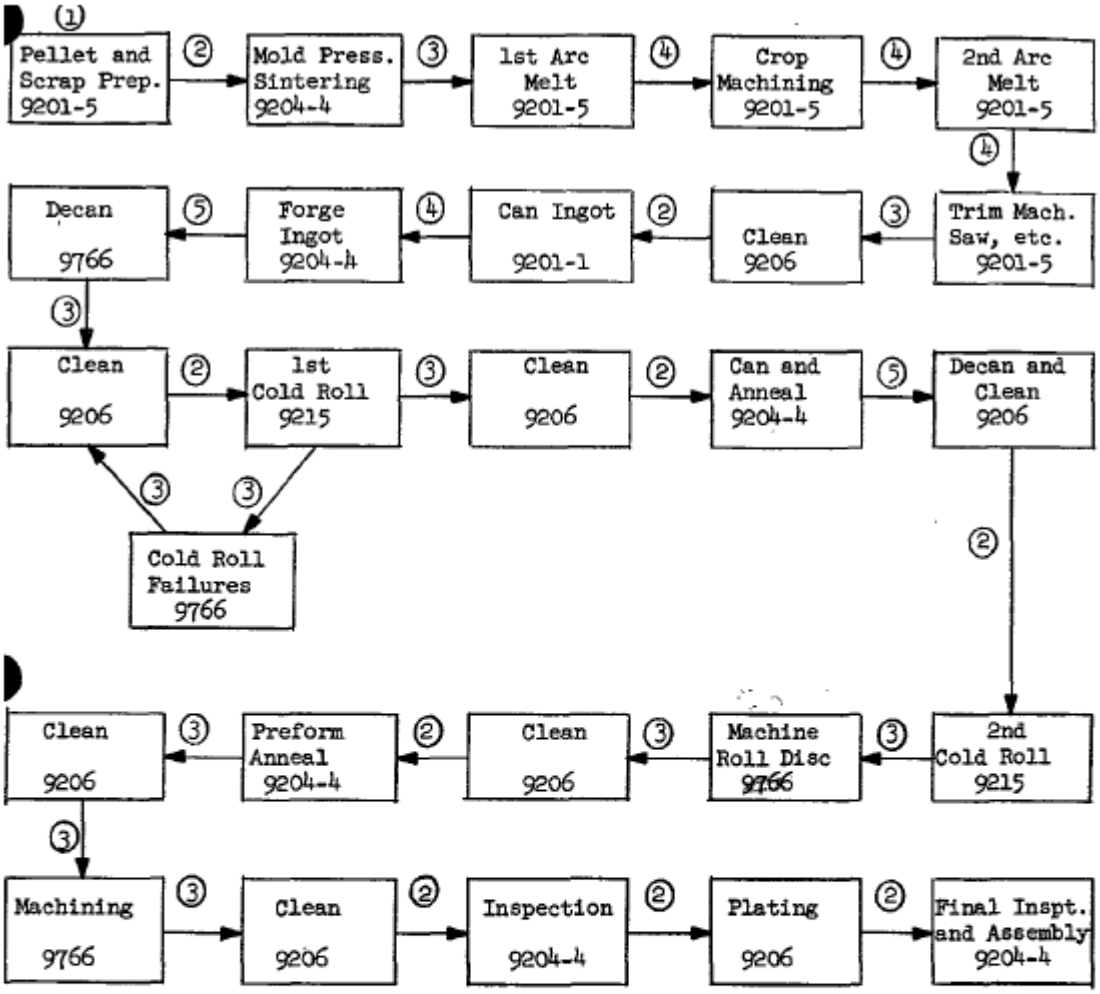
Employee interviews indicated that, after the cessation of major thorium operations, thorium processing (including arc melting) continued for:

- refurbishment of parts (through ~1989 time frame) and special projects (through the end of arc melting activities in 1999) (Personal Communication, 2018e).

- development of detector plates (Personal Communication, 2018e).

On December 8, 1999, there was a catastrophic event involving a Y-12 furnace which injured multiple employees (NaK Accident, 2000). As a result of this incident, arc-melting activities were suspended (Personal Communication, 2018e).

Fabrication: Thorium Flow Chart – Contamination Control



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① Unpacked in Control Area With Respiratory Protection.

② Health Physics "Green Tag" Transfer Clearance Required - Transfer in Container or Plastic Bag - No Other Special Precautions.

③ Health Physics "Contamination Tag" Required. Transfer in Container or Plastic Bag - Other Special Precautions As Prescribed on Tag.

④ Health Physics Survey not Required.

⑤ Health Physics Survey not Required Unless Can Failure During Operation.

NOTES

(a) All movements or transfers of thorium material from thorium control areas to non-thorium areas should be accompanied by appropriate Health Physics tag.

(b) All samples and specimens should be transferred on Health Physics "Green Tag".

Flow Chart, 1963

Figure 4-1: Thorium Flow Chart for Contamination Control

4.1.2 Plutonium-241 Operations

The following discussion provides a chronological overview of the Y-12 plutonium-241 operations conducted during the 1950s and 1960s. These operations were managed and staffed by ORNL but were conducted on the Y-12 physical footprint and, as such, are included in this evaluation report.

The electromagnetic separation of plutonium using a calutron was first proposed in 1950 for the purpose of generating Pu-240 material (Larson, 1950). The proposal also indicated that it would "be likely that simultaneous collections will be made of enriched Pu-241, Pu-242, and others." The initial charge (batch) was described as having 11 Curies of 5.1 MeV alphas and 125 Curies of 0.015 MeV betas. It was indicated that, from a health-hazard standard, the soft-beta activity was not significant in comparison to the alpha activity due to the low energy involved. The need for containment was indicated, and a facility that made use of glovebox enclosures was described. A facility for separation of plutonium isotopes (described as operating on a laboratory scale) was constructed by the Electromagnetic Research Division in Building 9204-3 (on the Y-12 campus). Work started in 1951 (Livingston, 1951a) and was completed in 1952 (Larson, 1952). The facility consisted of a processing laboratory, a calutron wash area, and designated calutron equipment (Livingston, 1951a). The facility had 16 gloveboxes and an enclosure for the calutron wash area. It also had areas for product packaging, storage, and shipping, which indicated that the product was most likely shipped directly from the 9204-3 facility area.

Several national laboratories expressed interest in obtaining samples of plutonium isotopes in 1951. In a letter dated December 20, 1951, the Atomic Energy Commission (AEC) requested information on the availability of Pu-241, Pu-242, and Pu-244 from the Plutonium Isotope Separation program (Kasschau, 1951, PDF p. 3); however, obtaining even a minute quantity was not feasible at that time.

The Electromagnetic Research Division originated as the Electromagnetic Research Laboratory (established at Y-12 in 1943) and became a part of ORNL in 1950 (Ball, 1971). The group's name was changed to the Electronuclear Division in 1953 (Ball, 1971). The Isotopes Division was organized at ORNL on May 1, 1957 and assumed responsibility for the electromagnetic separation of heavy elements on July 1, 1957. Health physics coverage for ORNL functions on the Y-12 campus were formally assumed by the ORNL Health Physics organization on April 1, 1954 (Hart, 1954).

Electromagnetic separation of plutonium isotopes was performed successfully in December 1953. The estimated yield was 0.5 gram of 50% Pu-240 and 0.2 gram of 10% Pu-241 (ORNL, 1954a, PDF p. 8). The $PuCl_3$ feed material assayed to be 5.1% Pu-240 and 0.4% Pu-241.

A second special electromagnetic separation of plutonium isotopes was performed in April 1954. The feed ($PuCl_3$) was assayed to be 93.9% Pu-239, 5·7% Pu-240, and 0.4% Pu-241. The three products obtained were: 6 grams of 99.5% Pu-239, 0.4 gram of 61% Pu-240, and 0.18 gram of 16% Pu-241 (ORNL, 1954b, PDF p. 9).

In May 1954, the Electronuclear Research Division at ORNL issued a *Catalogue of Uranium, Thorium, and Plutonium Isotopes* (Harmatz, 1954). Gram quantities of highly-enriched isotopes of uranium, thorium, and plutonium were prepared for use on projects sponsored by the AEC. The catalogue provided a table of available plutonium isotopes (including Pu-241) with their isotopic compositions.

Plutonium separations continued between 1954 and 1959; quantities were generally in the milligram range (Livingston, 1954a, 1954b, 1955, 1956a, 1956b, 1958; Seagren, 1958; ORNL, 1959) building up to a maximum reported quantity of 318 mg in October 1959 (ORNL, 1959k). Plutonium separation operations were suspended in November 1959 for "installation of a new recovery system" (ORNL, 1960). A logbook of one of the special separations operators (Scheitlin, 1957) states "plutonium operations shut down on Dec. 1 because of 'incident' at X-10 for review." A later reference states that operations were suspended in November 1959 to review the containment problem (Prater, 1963).

A new "doubly contained" facility was constructed in Building 9304-2 with operations commencing September 13, 1962 (Prater, 1963). After a year of operation, processing was suspended to allow for a "complete cleanup of equipment and maximum recovery of feed material." The separation activities averaged a feed rate of 0.68 g/hr for a total of 55 runs with an average run time of 55 hours. This corresponds to a total input of 1800 g of plutonium feed material. Pu-241 output is tabulated at 32 g of material with a purity of 89% to 96%.

Between 1964 and 1966, Pu-241 separation operations appear to have been sparse, with operations being shifted to the separation of uranium, thorium, and americium as well as the purification of Pu-238 and Pu-242 (ORNL, 1964; Rupp, 1965a, 1965b, 1965c, 1965d, 1965e, 1966a, 1966b; Love, 1966).

Between 1967 and 1968, operations were conducted involving tens of grams of Pu-241 with the stated objectives of separating 37 g of ~97% Pu-241 (Rupp, 1968) and 'milligram' quantities of Pu-241 containing < 10 ppm Pu-242 (i.e., 99.99% Pu-241) (Rupp, 1967).

4.2 Radiation Exposure Potential from Operations

The potential for internal and external radiation dose existed during both thorium and plutonium-241 operations at the Y-12 site. Based on the site operations outlined in Section 4.1, sources of exposure specific to thorium and plutonium-241 operations are detailed in Sections 4.2.1 and 4.2.2.

4.2.1 Exposure Potential from Thorium Operations

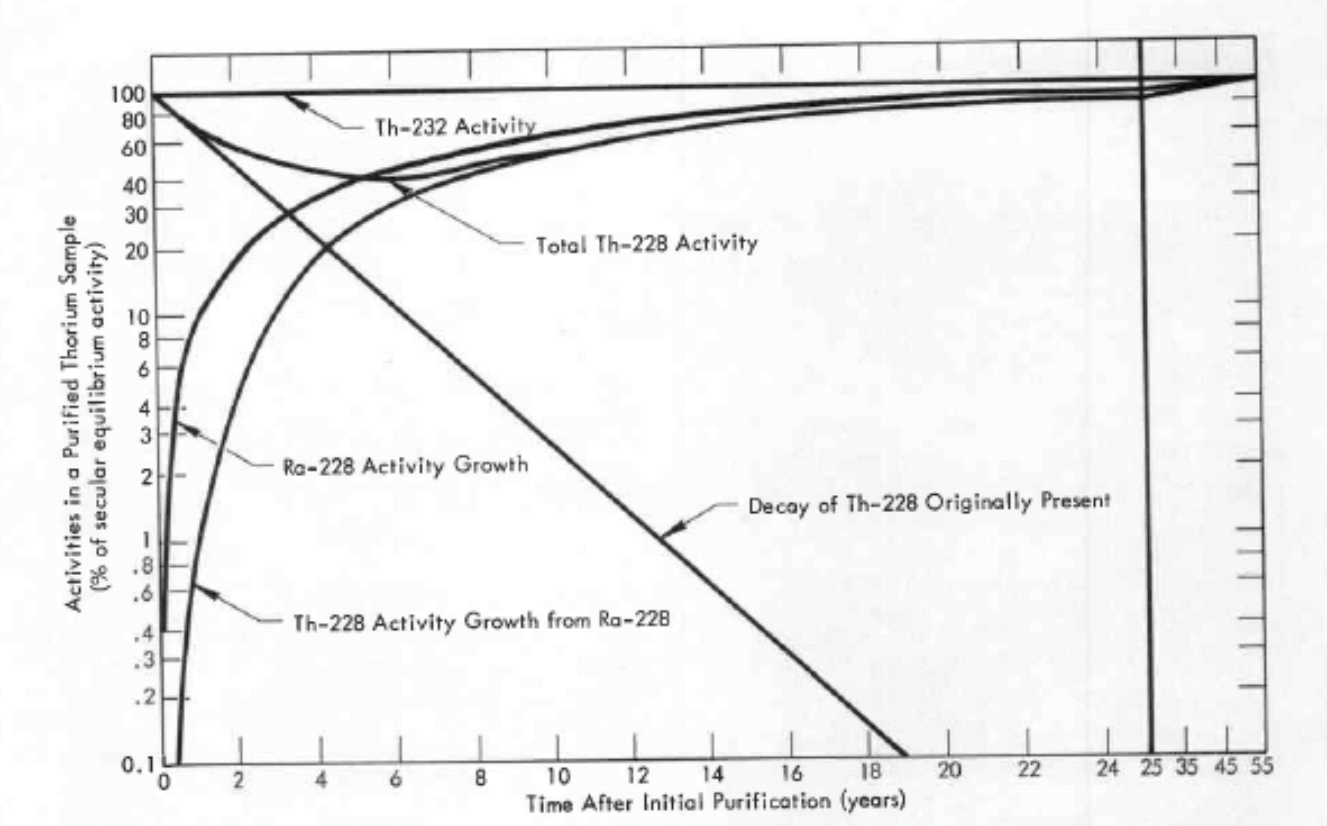
Natural thorium consists of a mixture of two thorium isotopes (Th-232 and Th-228), as well as a series of radioactive progeny. As shown in Table 4-2, the chain decays through ten steps involving seven alpha-emitters and four beta-emitters (gamma radiation is also emitted in the process).

Table 4-2: Radioactivity of the Thorium-232 Decay Series

Isotope	Half-Life	Alpha Energy (abundance alpha/ Th-232 Alpha)	Beta Energy (abundance beta/ Th-232 Alpha)	Gamma Energy (abundance gamma/ Th-232 Alpha)
Th-232	1.40E10 y	3.98 (1)	None	None
Ra-228	5.75 y	None	0.012(1)	None
Ac-228	6.15 h	None	0.46(0.13); 1.15(0.53); 1.72(0.07); 1.85(0.09); 2.18(0.10)	0.058(0.003); 0.129(0.034); 0.209(0.04); 0.270(0.03); 0.328(0.032); 0.338(0.092); 0.779(0.008); 0.790(0.045); 0.831(0.016); 0.908(0.25); 0.963(0.19)
Th-228	1.9116 y	5.338(0.28); 5.423 (0.72)	None	0.084(0.02)
Ra-224	3.66 d	5.194(0.004); 5.448(0.046); 5.681(0.95)	None	0.241(0.046)
Rn-220	55.6 s	6.282(1)	None	None
Po-216	0.145 s	6.775(1)	None	None
Pb-212	10.64 h	None	0.331(0.88); 0.569(0.12)	0.115(0.02); 0.176(0.01); 0.239(0.80); 0.300(0.05)
Bi-212	60.55 m	5.603(0.0037); 5.622(0.0005); 5.765(0.0068); 6.047(0.238); 6.086(0.092)	2.250(0.64)	0.040(0.013); 0.720(0.126); 0.800(0.109); 1.03(0.037); 1.34(0.034); 1.61(0.047); 1.81(0.047); 2.20(0.018)
Po-212	2.99E-7 s	8.78(0.66)	None	None
Tl-208	3.053 m	None	1.8(0.36)	0.277(0.035); 0.510(0.87); 0.582(0.28); 0.859(0.05); 2.62(0.347)

Source: Cofield, 1960

Undisturbed, the Th-232 and Th-228 activity reaches a state of equilibrium wherein the radiological activity of Th-232 and Th-228 are equal. Because of the half-lives of the nuclides in the thorium chain, removal of the Ra-228 component will result in a decrease in the Th-228 activity for a period of time, during which the Ra-228 activity will increase, as shown in Figure 4-2.



Source: West, 1965

Figure 4-2: Activities in a Purified Thorium Sample

The casting of ingots by consumable-electrode arc-melting was expected to produce a much greater disruption of the thorium decay chain than the other treatments such as acid "pickling," machining, forging, or shaping. The effects of arc melting were well studied by the health physics staff at Y-12 (Cofield, 1961; West. 1961a; West, 1965; West. 1977). Table 4-3 below provides a summary of the relative Th-232/Th228 and Ra-228/Ra-224 ratios that were seen during various portions of the process.

Table 4-3: Th-232/Th-228 and Ra-228/Ra-224 Ratios Seen During the Y-12 Thorium Process

Sample Number	Description	Date of Analysis (Days after Melting or Use)	Ra-228/ Ra-224 Activity Ratio, γ-method	α/ß Count Rate Ratio	Th--232/ Th-228 Activity Ratio
C-3	Rod starting material	No Data	0.98	0.79	2.23
C-7	1st melt, 1st cut, 1st ingot	27	6.2	No Data	No Data
C-7	1st melt, 1st cut, 1st ingot	265	2.3	0.52	1.30
C-15	1st melt, 2nd cut, 1st ingot	32	0.4	No Data	No Data
C-15	1st melt, 2nd cut, 1st ingot	265	0.7	0.99	1.95
C-17	1st melt, 2nd cut, 1st ingot	32	2.6	No Data	No Data
C-17	1st melt, 2nd cut, 1st ingot	265	1.9	0.60	1.08
C-38	2nd melt, 1st cut, 1st ingot	14	0.65	No Data	No Data
C-38	2nd melt, 1st cut, 1st ingot	246	0.83	0.85	2.10
C-34	2nd melt, interior cut, 1st ingot	14	0.18	No Data	No Data
C-34	2nd melt, interior cut, 1st ingot	246	0.38	0.93	2.19
C-131	2nd melt metal, final machining	48	0.15	No Data	No Data
C-131	2nd melt metal, final machining	259	0.38	1.05	2.28
M-5	"Pickle" solution─rod starting material	68	1.6	No Data	No Data
M-5	"Pickle" solution─rod starting material	313	1.4	0.97	1.30
M-7	"Pickle" solution─1st melt ingots	28	21.3	No Data	No Data
M-7	"Pickle" solution─1st melt ingots	315	3.4	0.43	0.33
M-8	"Pickle" solution─2nd melt material after machining	47	0.17	No Data	No Data
M-8	"Pickle" solution─2nd melt material after machining	315	0.41	1.09	1.56
M-28	1st melt furnace liner smear	14	38.5	No Data	No Data
M-28	1st melt furnace liner smear	281	4.6	0.32	0.05
M-44	2nd melt furnace liner smear	56	43.8	No Data	No Data
M-44	2nd melt furnace liner smear	252	5.3	0.39	0.06
A-1	Air sample during unloading of 2nd melt ingot from furnace	54	48.3	No Data	No Data
A-1	Air sample during unloading of 2nd melt ingot from furnace	309	4.4	0.41	0.13

Source: Cofield, 1961

Tale 4-3 details the distribution patterns observed during a study of Y-12 thorium processing (Cofield, 1961). This study provided the following conclusions related to the distribution of thorium progeny during the operations:

- The two processes of arc melting remove essentially all of the radium from the interior of thorium ingots. The Ra-224 and its sub-series quickly return to equilibrium with the Th-232 and Th-228.

- In the arc-melting removal of radium, much of the radium in both the first and second melting is vaporized, resulting in a deposit of thorium-free radium on the furnace liner.

- In the ingot itself, on both first- and second-melt ingots, the outermost layers contain the highest radium enrichments, with the second-cut layer containing a smaller amount, and the interior the least. In the interior of the ingots, there appears to be a slight gradient, with the top of the ingot being more depleted of radium than the bottom.

The material dissolved from the starting material in "pickling" has a slight radium enrichment, probably because of the last previous casting of the metal. "Pickling" solutions from first-melt ingots before machining contain high radium enrichment. Although second-melt ingots were not "pickled" before machining, material dissolved from the second-melt later in the process showed radium depletion, relative to the starting material.
In summary:

- The arc melting of thorium effectively removes the radium and other daughters from thorium, but all of the daughters except Ra-228 and Ac-228 return very quickly and remain with the Th-228 present.

- The arc melting of thorium releases large quantities of Ra-228 (in the casting of a typical 200-kg ingot of thorium, about 9.6 mCi of Ra-228 will be removed with more than one-half or at least 5 mCi of this radioisotope vaporized completely out of the ingot). The Ra-228 is likely to be much more of a radiological hazard as 5 mCi of separated material than it was when distributed in 200 kg of metal.

4.2.2 Exposure Potential from Plutonium-241 Separation

Plutonium-241 has a half-life of 14.4 years and a specific activity of 104 Ci/g. The primary decay mode is beta emission with a maximum energy of 20.8 keV. This low-energy beta emission cannot be detected by standard beta/gamma counting. The bioassay method employed beginning in 1967 entails an ion exchange separation and fluoride precipitation (to isolate the Pu) followed by liquid-scintillation counting (Henley 1978).

As indicated in Section 4.1.2, Pu-241 operations were suspended in November 1959 and not restarted until September 1962 when a new processing facility was constructed. It is unclear if there was an actual problem with the containment system in use in Building 9204-3 or if the cited authors were referring to a site-wide stand-down of chemical-processing operations due to a release from the thorex pilot plant earlier that year. The ORNL Incident Database indicates events in March and September 1959 but provides no details (ORNL, 1974a, 1974b). Available progress reports prior to the 1959 shutdown indicate some airborne activity problems early on. For example, the Electromagnetic Research Division progress report for March 1953 stated: “Problems of airborne contamination became somewhat better defined as actual operations with plutonium provided data. As expected, those operations involving transfers of calutron units from one enclosure into another were the most troublesome, and airborne activities several times the permissible levels for operation without respiratory protection were often encountered. However, the present use of plastic bags for such

transfers appears adequate for research-scale operations" (Livingston, 1953). The March 1955 progress report states "airborne alpha activity continues to be below tolerance levels" and "minor contamination on the outside of glove-box surfaces was noted by chemistry operations and has been controlled by occasional painting" (Livingston, 1955).

4.3 Time Period Associated with Radiological Operations

Per the DOE Office of Health, Safety and Security, the time period associated with DOE operations at the Y-12 site is from August 13, 1942 to the present (DOE, 2010). Time periods specific to the Y-12 operations under evaluation in this report are as follows:

- Arc-melting operations began in 1959 (Hibbs, 1961) and continued through 1999 (Personal Communication, 2018e).
- Pu-241 separations activity began in 1953 and continued through 1973 (ORNL, 1998).

4.4 Site Locations Associated with Radiological Operations

NIOSH has determined that the site-specific and claimant-specific data available for the period from January 1, 1958 through December 31, 1976, do not allow NIOSH to characterize employee movements across the Y-12 site. NIOSH is therefore unable to define individual employee exposure scenarios based on specific work locations within Y-12 during the period under evaluation.

4.5 Job Descriptions Affected by Radiological Operations

NIOSH has determined that the site-specific and claimant-specific data available for the Y-12 Plant for the time period under evaluation are insufficient to allow NIOSH to determine that any specific work group was not potentially exposed to radioactive material releases or possible subsequent contamination.

NIOSH has insufficient information associating job titles and/or job assignments with specific thorium or plutonium-241 separation activities. Without such information, NIOSH is unable to define potential radiation exposure conditions based on worker job descriptions. What is known in more general terms is provided below in Sections 4.5.1 and 4.5.2.

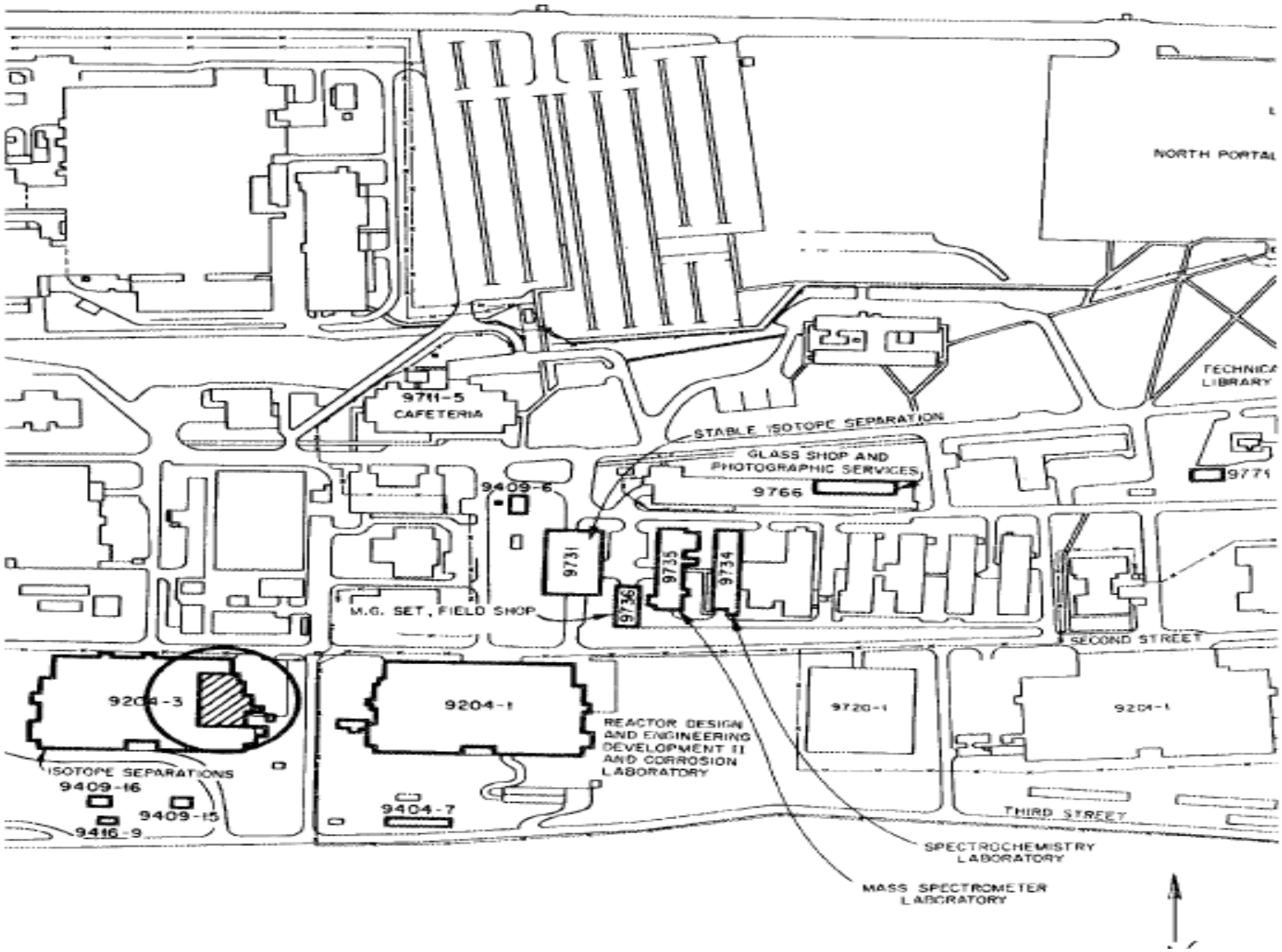
4.5.1 Job Descriptions Affected by Thorium Operations

Although NIOSH does not have a list of thorium-specific job titles, work with thorium would have generally involved machinists, maintenance, and engineering staff.

4.5.2 Job Descriptions Affected by Plutonium-241 Separation

NIOSH endeavored to understand the nature and extent of personnel involvement in plutonium separation activities in Building 9204-3. As stated earlier, the operation was located on the Y-12 campus but was managed by the ORNL X-10 organization (initially, the Electronuclear Division; later, the Isotopes Division). The plutonium operation occupied only a portion of Building 9204-3, as shown encircled in Figure 4-3. That building also housed the 63-inch cyclotron (Ball, 1971). Organizational charts for the Special Separations group of the Electronuclear Division are available within the Electronuclear Division progress reports issued during the early 1950s; these reports indicate a staff level of less than 20 individuals (Livingston, 1950, 1951b, 1954). This staff level is consistent with the number of individuals monitored in the bioassay program, which can be ascertained from: (1) bioassay records in the early-1950s bioassay reports (24 individuals monitored); (2) the 1965 bioassay card collection (17 individuals monitored); and (3) the 1967 type-000 bioassay card collection (19 individuals monitored).

It is also clear that facility access was not limited to ORNL personnel. Examples of individuals with 9204-3 specified as a work area can be found within the 1965 bioassay card collection for Y-12 employees (e.g., [name redacted]—Division 2018) and contractors (e.g., [name redacted]—HKF). Access to the complete bioassay card collection would be needed to determine the extent to which Y-12 and contractors accessed the plutonium facility within 9204-3 because the data are not within the currently-available electronic database systems.



Source: Banic, 1973

Figure 4-3: Location of ORNL Operations on the Y-12 Campus

5.0 Summary of Available Monitoring Data for the Proposed Class

The primary data used for determining internal exposures are urinalyses, fecal samples, and whole-body counting results. If these are unavailable, the air monitoring data from breathing zone and general area monitoring are used to estimate the potential internal exposure. If personal monitoring and breathing zone area monitoring are unavailable, internal exposures can sometimes be estimated using more general area monitoring, process information, and information characterizing and quantifying the source term.

This same hierarchy is used for determining the external exposures to the cancer site. Personal monitoring data from film badges or thermoluminescent dosimeters (TLDs) are the primary data used to determine such external exposures. If there are no personal monitoring data, exposure rate surveys, process knowledge, and source term modeling can sometimes be used to reconstruct the potential exposure.

A more detailed discussion of the information required for dose reconstruction can be found in OCAS-IG-001, *External Dose Reconstruction Implementation Guideline,* and OCAS-IG-002, *Internal Dose Reconstruction Implementation Guideline*. These documents are available at: http://www.cdc.gov/niosh/ocas/ocasdose.html.

5.1 Data Capture Efforts and Sources Reviewed

As a standard practice, NIOSH completed an extensive database and Internet search for information regarding the Y-12 Plant. The database search included the DOE Legacy Management Considered Sites database, the DOE Office of Scientific and Technical Information (OSTI) SciTech Connect database, and the Hanford Declassified Document Retrieval System. In addition to general Internet searches, the NIOSH Internet search included OSTI OpenNet Advanced searches, Nuclear Regulatory Commission (NRC) Agency-wide Documents Access and Management (ADAMS) web searches, and the DOE-National Nuclear Security Administration-Nevada Site Office-search. Attachment 5 contains a summary of the Y-12 Plant 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.

5.2 Previous Dose Reconstructions

NIOSH reviewed its NIOSH DCAS Claims Tracking System (referred to as NOCTS) to locate EEOICPA-related dose reconstructions that might provide information relevant to the petition evaluation. Table 5-1 summarizes the results of this review. (NOCTS data available as of October 26, 2018).

Table 5-1: No. of Y-12 Plant Claims Submitted Under the Dose Reconstruction Rule

Description	Totals
Total number of claims submitted for dose reconstruction	6414
Total number of claims submitted for energy employees who worked during the period under evaluation (January 1, 1958 through December 31, 1976).	3184
Total number of claims submitted for energy employees who started their employment during the period under evaluation (January 1, 1958 through December 31, 1976)	2107
Number of dose reconstructions completed for energy employees who worked during the period under evaluation (i.e., the number of such claims completed by NIOSH and submitted to the Department of Labor for final approval).	2816
Number of claims for which internal dosimetry records were obtained for the identified years in the evaluated class definition	1003
Number of claims for which external dosimetry records were obtained for the identified years in the evaluated class definition	1422

NIOSH reviewed each claim to determine whether internal and/or external personal monitoring records could be obtained for the employee. About 32% of the claims had internal dosimetry records, and about 45% had external dosimetry records. Between 1958 and 1960, only approximately 20% of the Y-12 workforce was monitored for external dose. The time period associated with the number of claims with external dosimetry is January 1, 1958 through December 31, 1976, so it is not possible to draw conclusions as to whether the implied monitoring ratio for the entire period (1422 divided by 3184) is consistent with a 90%+ monitoring frequency for the period starting in 1961.

5.3 Employee Interviews

To obtain additional information, NIOSH interviewed in person five former Y-12 employees:

- Personal Communication, 2012, *Personal Communication with Former Oak Ridge National Laboratory employee;* Telephone Interview by ORAU Team and NIOSH; March 15, 2012, SRDB Ref. ID 110639

- Personal Communication, 2018a, *Personal Communication with Former Y-12 Plant employee*; In-person Interview by ORAU Team; August 15, 2018; SRDB Ref ID: 173936

- Personal Communication, 2018b, *Personal Communication with Former Y-12 Plant employee*; In-person Interview by ORAU Team; August 16, 2018; SRDB Ref ID: 173937

- Personal Communication, 2018c, *Personal Communication with Former Y-12 Plant employee*; In-person Interview by ORAU Team; August 16, 2018; SRDB Ref ID: 173938

- Personal Communication, 2018d, *Personal Communication with Former Y-12 Plant employee*; In-person Interview by ORAU Team; August 16, 2018; SRDB Ref ID: 173939

- Personal Communication, 2018e, *Personal Communication with Former Y-12 Plant employee*; In-person Interview by ORAU Team; August 16, 2018; SRDB Ref ID: 174343

5.4 Internal Monitoring Data

5.4.1 Internal Monitoring Data for Thorium Operations

For the period under evaluation, NIOSH has access to a spreadsheet containing 10,307 thorium lung count results spanning the period from 1958 through 1982 (Thorium Lung Counts, 2005; West, 1961b; West 1961c). This data file contains results in units of total thorium (mg). These measurements were performed at the Y-12 *in vivo* counting facility using an NaI detector system and evaluation of the 240 keV Pb-212 photo peak, and the 330 and 900 keV Ac-228 photo peaks (Cofield, 1960; Scott, 1965). The system was calibrated using a source with a Th-232/Th-228 activity ratio of 1.27 and Th-232/Ra-228 activity ratio of 1.67 (Scott, 1965). Y-12 health physics staff were well aware of how sensitive the measurement results were to the Th-232/Th-228 activity in the actual material inhaled. Staff indicated that a ratio of less than 1.27 would result in an underestimate and a ratio greater than 1.27 would result in an overestimate (West, 1961d). The method is described as being "qualitative" but with the ability to be made quantitative "by establishing or estimating thorium to daughter ratios."

No measurement data for Ra-228 has been located. However, the lung counting method used was described as being capable of measuring Ra-228. The method was described as entailing "repeated measurement of a long period of time and observation of the decay and grow-in patterns." The Ra-228 intake (if determined) is indicated as being additive to the thorium lung burden (Scott, 1965).

In vivo measurements were the primary method used to measure potential exposure to thorium. This is indicated in the first quarter 1963 quarterly health physics report, which indicates "The *In Vivo* Radioactivity Measurement (IVRM) Facility, or body counter, is the only available monitoring device used for checking persons who work routinely in thorium areas" (Quarterly Report, 1963Q1).

Figure 5-1 shows the solid-line plot of the number of thorium counts available for each year. The dashed-line plot shows the number of thorium counts contained within a collection of NOCTS files for Y-12 claimants. For the NOCTS dataset, thorium lung count data from all available Y-12 claims were compiled up to NOCTS claim number 48453, comprising 2105 individual claims. Thorium lung count data was located within 609 of the 2105 claims.

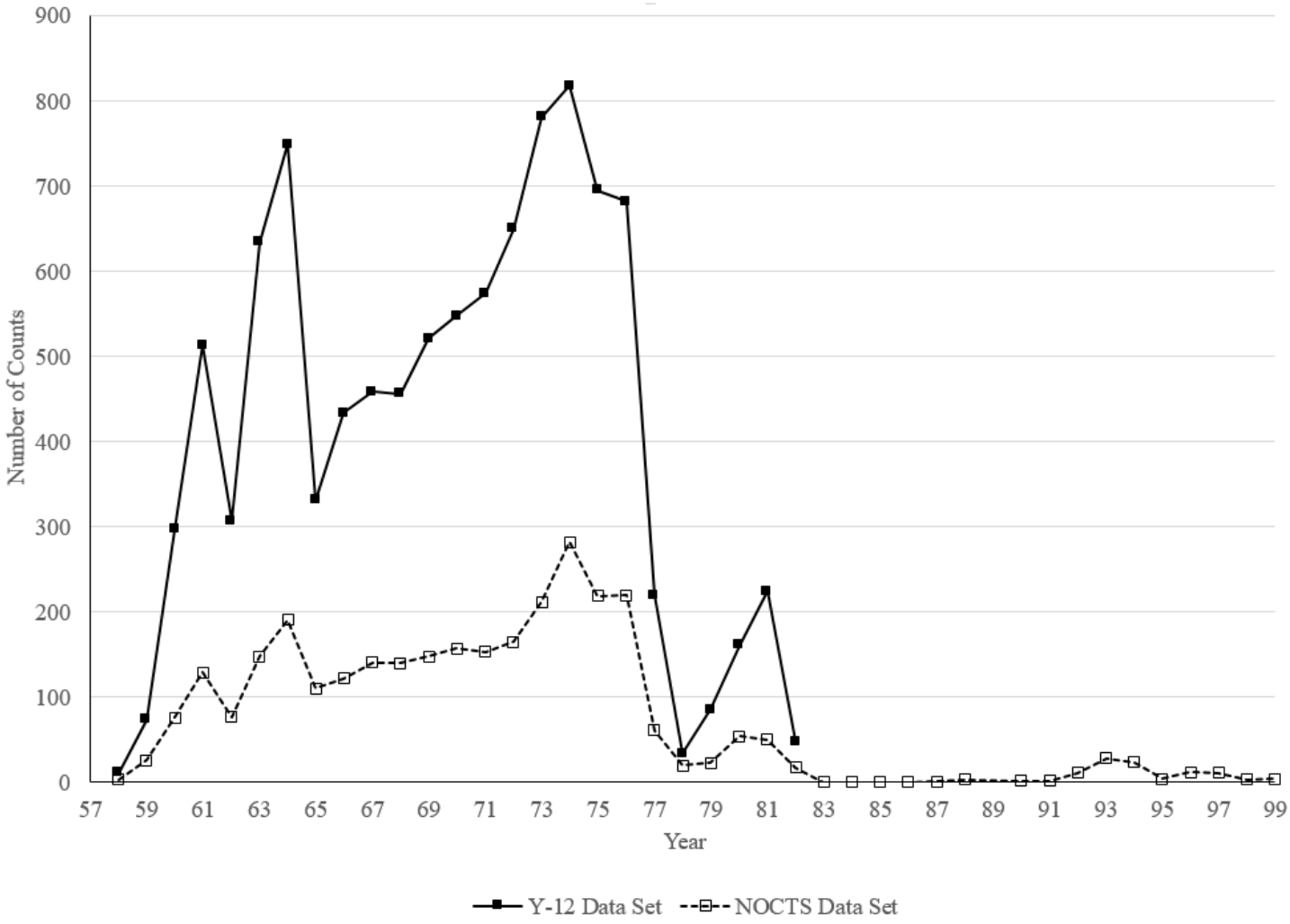


Figure 5-1: Thorium Lung Count Measurements

In addition to the lung-count dataset, individual data sheets are available for counts performed in 1983. Approximately 3200 individual datasheets are available, each indicating a recorded result for lead and actinium with no indication that thorium mass would be recorded. These sheets all have a revision date of October 1978 which would seem to be consistent with an annotation in the second quarter 1977 quarterly report that reads "work continued on our effort to improve our *in vivo* method

of monitoring for thorium. NIOSH verified a program modification which calculated gamma activities of Ac-228 and Pb-212. These activities can be related to the amounts of Th-232 and Th-228, respectively, and should improve NIOSH's ability to estimate lung burden to these thorium isotopes (Quarterly Report, 1977Q2).

5.4.2 Internal Monitoring Data for Plutonium-241 Separation

The potential hazard of the Pu-241 work was recognized as early as August 1950 (Larson, 1950) and it appears that containment and control actions were initiated consistent with any other plutonium facility. A detailed description of the 1962 facility is contained in the report, *Radiation Safety and Control for the Electromagnetic Isotope Separation of the Heavy Elements in Building 9204-3, Including Operational and Facility Layouts* (Banic, 1973). The facility included air and contamination monitoring equipment typical for a plutonium facility.

Problems detecting Pu-241's low-energy beta emissions appear to have been known, based on a 1959 logbook entry that recognized the nature of the radiation emissions and the difficulty of detecting them with current instrumentation (Scheitlin, 1957). This entry states: "Our health physics people have no way of monitoring this very weak beta (tritium counter too insensitive for Pu)." Another entry in this same logbook (on July 7, 1960) indicates that a 17 keV wound detector (scintillation detector and single-channel analyzer) was available and that [name redacted] (Y-12 Medical) was interested. An entry stating "They do not now have one" is annotated "They got one later" so it would appear that there was an effort to monitor for Pu-241 in wounds.

The earliest monitoring data for the special separations group in Building 9204-3 can be compiled from a series of bioassay monitoring reports specific to ORNL employees at Y-12. These reports span from October 1952 to December 1954. It is not clear whether the reports stopped in December 1954 or if they are just unavailable. A total of 231 plutonium bioassay samples (42 being blanks) were provided for 24 individuals over a 26-month period. It would appear that monthly sampling was generally provided for individuals during periods where exposure was likely. Attachment 1 provides a summary of the bioassay sample frequency; Attachment 2 presents the corresponding results. (NOTE: These results do not represent Pu-241, but rather, alpha-emitting plutonium isotopes).

Since the SRDB has a complete set of all Type-000 bioassay cards (i.e., special samples), and the cards specify the location monitored, NIOSH used these cards to characterize the monitoring frequency for Building 9204-3 workers. In 1965, 1966 and 1967, a series of type-000 samples were collected and analyzed for americium. A total of 45 samples from 16 individuals were collected between February 1965 and October 1967. All of the individuals had 9204-3 listed on the bioassay cards. Because the SRDB has a complete set of 1965 ORNL bioassay cards, the complete monitoring frequency for the 9204-3 workers identified using type-000 cards was compiled. Attachment 3 contains a summary of the available data. These data indicate that, as with the 1952–1954 data, individuals within Building 9204-3 were monitored frequently for plutonium intakes (135 Pu or Gross Alpha bioassay samples for 11 individuals over a 12-month period). Again, it appears as though monitoring was provided on a monthly basis.

Pu-241-specific bioassay data are available starting in 1967 (earliest sample: 1/29/67). A May 1968 listing of bioassay methods shows Pu-241 (Code PU1) annotated with the comment "new method" (Gupton, 1969). For this reason, NIOSH does not believe there are data prior to 1967 that are missing. Attachment 4 provides a summary of the available data. A total of 222 samples were collected from 45 people between 1967 and 1985. One-third of the sampling was conducted in 1967 alone (74 samples).

Although Pu-241 is not generally monitored through lung-counting, the long-lived progeny (Am-241) can be. The frequency at which Am-241 has been detected in Pu-241 workers cannot be ascertained with the available data; however, one instance of an Am-241 intake being attributed to a Pu-241 intake has been found in a former Building 9204-3 worker's exposure history file (Log Entry, undated).

5.5 External Monitoring Data

NIOSH has access to photon, beta, and neutron external dosimetry results, as well as other supporting data representing Y-12 site operations throughout the time period under evaluation in this report. Details regarding the various analyses used, and the associated minimum detectable activities, are presented in ORAUT-TKBS-0014-6. To assess potential external dose to unmonitored employees, NIOSH developed a co-worker dose distribution model (ORAUT-OTIB-0064).

5.6 Workplace Monitoring Data

NIOSH has a spreadsheet (Spreadsheet, 1960-76) containing the results (in dpm/m^3) of 79,997 air samples specific to thorium operations that span the period from 1960 through 1976. These air sample results appear to have been fixed sample locations based on there being an assigned "locations" ID provided with each location. Identifying information is only available for a subset of the locations codes (9201-5, 9202, 9203, 9204-4, 9206, 9215, 9766, and 9728). It should be noted that when evaluating the dataset, an inherent decimal point must be assumed between the last two digits. This was confirmed by comparing data within the dataset with hardcopy records with the same dates/locations. For example, based on the Daily Thorium Report for 11-1-1961 (Thorium Reports, 1961, PDF p. 37), the results for Julian day 297, 298, and 299 are 1.3, 4.2, and 4.5 dpm/m^3, respectively. The corresponding values in the data spreadsheet for these locations on these days are 13, 42, and 45 dpm/m^3, respectively. Figure 5-2 shows the number of samples collected by year. Table 5-2 shows the annual average air activity (in dpm/m^3) for gross alpha air samples collected in thorium areas.

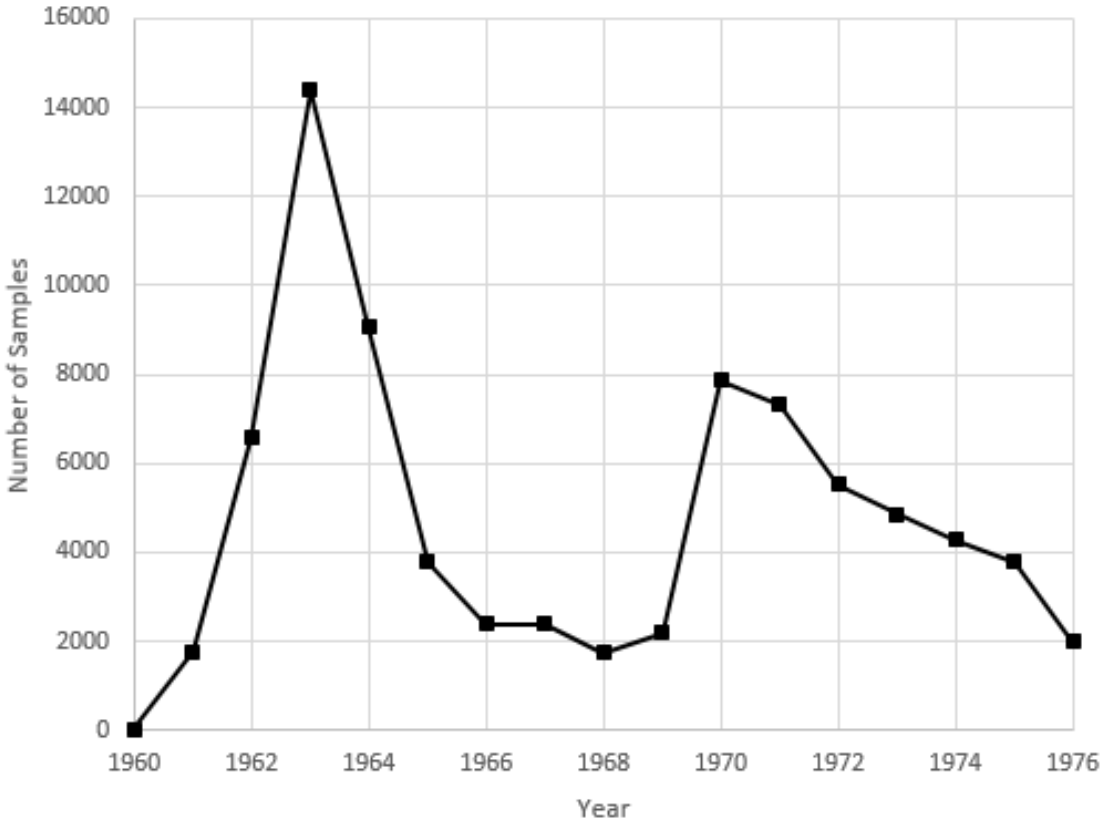


Figure 5-2: Gross Alpha Air Samples Collected By Year (1960-1976)

Table 5-2: Annual Average Air Activity for Gross Alpha Air Samples in Thorium Areas (dpm/m^3)

Year	Samplers	Minimum	Maximum	Average
1960	30	0.1	10.7	2.1
1961	1780	0	11.7	2.1
1962	6579	0	11.9	1.4
1963	14394	0	11.9	1.8
1964	9069	0	19.4	1.7
1965	3786	0	19.9	1.2
1966	2391	0	19.5	1.3
1967	2390	0	19.8	1.4
1968	1743	0	19.7	2.6
1969	2188	0	19.7	3.5
1970	7872	0	19.9	2.3
1971	7327	0	96.1	2.8
1972	5537	0	97.8	2.8
1973	4854	0	99.0	2.3
1974	4285	0	96.3	2.5
1975	3781	0	76.5	0.8
1976	1991	0	43.7	0.7

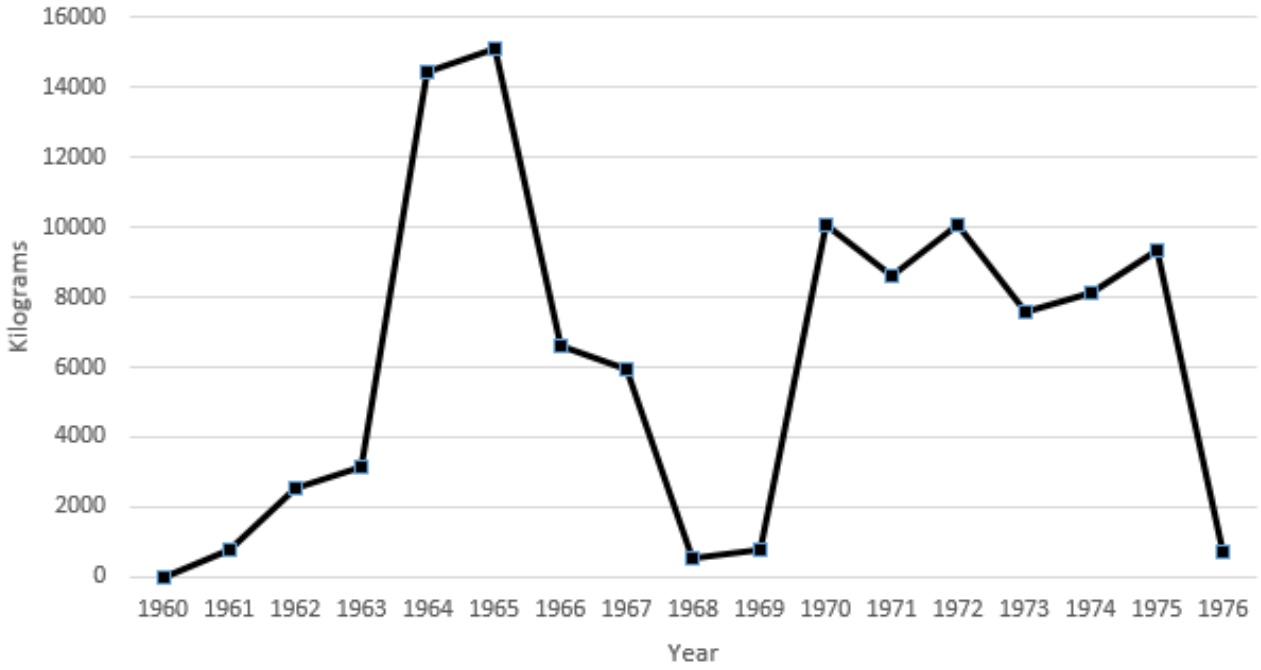
The air monitoring program implemented by Y-12 for thorium work areas included provision for alpha, beta/gamma counting, and evaluation of both long- and short-lived alpha and beta/gamma activity contained on the samples (Air Sample Counting, 1966). Based on the evaluation methodology, concentrations of long-lived thorium activity was determined as well as an estimate of short-lived Ra-224 activity. The Ra-224 activity was used to evaluate the potential presence of unsupported Ra-228. Although the surviving program documentation attests to the collection of these data (Air Sample Counting, 1966; Wiley, 2005), only the tabulated long-lived alpha activity data (described above) are available.

A review of quarterly reports from the 1960s and 1970s indicates that gross alpha air samples greater than a preset screening level (20 dpm/m^3 in 1964) were analyzed chemically for thorium content. No comprehensive collection of thorium analysis data for air samples is available to NIOSH.

5.7 Radiological Source Term Data

5.7.1 Radiological Source Term Data for Thorium Operations

Data on thorium inventory are not readily available. Figure 5-3 summarizes the available information on thorium transfers to the onsite burial ground.



Source: Owings, 1995

Figure 5-3: Thorium Transfers to the Onsite Burial Ground

5.7.2 Radiological Source Term Data for Plutonium-241 Separation

Table 5-3 provides an annual summary of Pu-241 quantities produced based on a review of selected Electronuclear Division Progress Reports, September 1953–October 1957 (Livingston, 1954a, 1954b, 1955, 1956a, 1956b, 1958), the Isotopes Division Annual Report for 1957 (Seagren, 1958); ORNL Monthly Status and Progress Reports, 1958–1959 (ORNL, 1958a–c, 1959a–k, 1960), and as indicated in a 1998 Isotopes Division Summary Report (ORNL, 1998).

Table 5-3: Pu-241 Production Quantities for the Building 9204-3 Plutonium Facility

Year	Quantity (g)	Purity (% Pu-241)
1954	0.630	15%–30%
1955	0.226	15%–51%
1956	0.185	28%–40%
1957	0.889	34%–62%
1958	0.021	90%
1959	0.468	81%
1960	No Data	No Data
1961	No Data	No Data
1962	No Data	No Data
1963	28.534	95%
1964	11.087	86%–94%
1965	No Data	No Data
1966	32.523	93%
1967	48.837	94%–99%
1968	No Data	No Data
1969	No Data	No Data
1970	No Data	No Data
1971	No Data	No Data
1972	46.554	48%–93%
1973	36.916	93%–97%

6.0 Feasibility of Dose Reconstruction for the Proposed Class

42 C.F.R. § 83.14(b) states that HHS will consider a NIOSH determination that there was insufficient information to complete a dose reconstruction, as indicated in this present case, to be sufficient, without further consideration, to conclude that it is not feasible to estimate the levels of radiation doses of individual members of the class with sufficient accuracy.

In the case of a petition submitted to NIOSH under 42 C.F.R. § 83.9(b), NIOSH has already determined that a dose reconstruction cannot be completed for an employee at the DOE or AWE facility. This determination by NIOSH provides the basis for the petition by the affected claimant. Per § 83.14(a), the NIOSH-proposed class defines those employees who, based on completed research, are similarly affected and for whom, as a class, dose reconstruction is similarly not feasible.

In accordance with § 83.14(a), NIOSH may establish a second class of co-workers at the facility for whom NIOSH believes that dose reconstruction is similarly infeasible, but for whom additional research and analysis is required. If so identified, NIOSH would address this second class in a separate SEC evaluation rather than delay consideration of the claim currently under evaluation (see Section 10). This would allow NIOSH, the Board, and HHS to complete, without delay, their consideration of the class that includes a claimant for whom NIOSH has already determined a dose reconstruction cannot be completed, and whose only possible remedy under EEOICPA is the addition of a class of employees to the SEC.

This section of the report summarizes research findings by which NIOSH determined that it lacked sufficient information to complete the relevant dose reconstruction and on which basis it has defined the class of employees for which dose reconstruction is not feasible. NIOSH's determination relies on the same statutory and regulatory criteria that govern consideration of all SEC petitions.

6.1 Feasibility of Estimating Internal Exposures

NIOSH has evaluated the available employee and workplace monitoring data and source term information and has determined that there are insufficient data for estimating internal exposures, as described below. This evaluation has been completed for the period from January 1, 1958 through December 31 1976. NIOSH is continuing to evaluate the period beginning January 1, 1977 to determine if thorium-related infeasibility issues continued beyond the recommended SEC class period of 1958-1976.

6.1.1 Feasibility of Estimating Internal Exposures from Thorium Operations

HHS has designated an SEC class for Y-12 workers for the period from January 1, 1948 through December 31, 1957 (HHS, 2011). In the class designation letter, HHS states there are:

> *… insufficient personnel or area monitoring data, source term data, and operational information to support assessing internal dose from thorium and cyclotron radionuclides with sufficient accuracy during the period from January 1, 1948 through December 31, 1957 for all workers at the Y-12 Plant in Oak Ridge, Tennessee.*

In regard to thorium exposure during the period currently under evaluation (January 1, 1958 through December 31, 1976), NIOSH has located both personnel monitoring data (~10,000 thorium lung counts) and air monitoring data (~80,000 gross alpha air sample results). These monitoring data indicate that Y-12 was actively monitoring thorium exposure and that exposure monitoring data (specifically thorium lung counts) are retrievable on an individual basis.

NIOSH has reviewed the available thorium lung count data and determined that the results were recorded in units of total thorium mass and were performed on a counting system that is functionally identical to the mobile version of the system. The mobile version of the Y-12 counting system (MIVRML) was used at the Fernald Site from January 1, 1968 through December 31, 1978. In the case of the Fernald site, HHS has designated an SEC class related to thorium workers monitored using this system. The Fernald class designation letter (HHS, 2012) stated the following:

> *… the NIOSH Director and the Board determined that MIVRML results expressed as thorium milligrams could not be interpreted with confidence and consequently the reconstructed doses based on such an approach may not be done with sufficient accuracy. Therefore, the Board and the NIOSH Director concluded that it was not feasible to reconstruct with sufficient accuracy doses from internal thorium exposures for the years 1968-1978.*

Because the system used at Y-12 reported results in the same manner (i.e., mg of thorium), and shared the same calibration and data interpretation methods as the one employed at Fernald (see Section 5.4.1) (Personal Communication, 2012), and because the actual Th-232/Th-228 ratio for the material that a person was exposed to cannot be determined, NIOSH use of the Y-12 *in vivo* counting system data is subject to the same limitations that were evaluated for Fernald. For these reasons, NIOSH concludes that the available mass-based lung-count data cannot be used to reconstruct exposure to thorium with sufficient accuracy at the Y-12 Plant.

NOTE: As discussed in Section 5.4.1, there are indications that isotopic-specific results (i.e., Ac-228 and Pb-212) might be available starting in 1977. NIOSH has not ascertained the availability of these data at this time; therefore, it will continue to evaluate the feasibility of internal dose reconstruction for thorium at the Y-12 site beginning January 1, 1977.

NIOSH has evaluated the available gross alpha air monitoring data at Y-12 and determined that it cannot be used to accurately reconstruct internal exposure from thorium and associated progeny for the following reasons:

- The air monitoring data represent gross alpha activity at fixed sample collection points. Such data does not necessarily represent the concentration in an individual worker's breathing zone.

- The air data were collected over a time period likely different from when an individual might be present in the same area. As such, these data do not accurately represent potential episodic exposures, but rather, provide an average exposure during the sampling interval.

- Arc melting of thorium preferentially releases Ra-228 and results in a disruption of predictable Th-232/Th-228 ratios in work areas (as described in Section 4.2.1 and shown in Table 4-3).

- The data only provide long-lived alpha concentrations and cannot be used to establish exposure to radium-228, which is a beta/gamma-emitter; nor can it be used to determine thorium-232 and thorium-228 component intakes. In order to do so, it would be necessary to know the ratios of these nuclide activities relative to total thorium activity. Such data are not available to NIOSH.

NIOSH cannot use source term data to determine internal exposures because such data are not available to NIOSH.

6.1.2 Feasibility of Estimating Internal Exposures from Plutonium-241 Separation

NIOSH does not have any personnel or workplace monitoring data specific to plutonium-241 for the period from January 1, 1954 through December 31, 1966. During this time period, the only monitoring data available for individuals working with this material would have been either gross alpha or specific to plutonium-239/240. Pu-241 has a specific activity that is 1,600 times that of Pu-239, and 450 times that of Pu-240. From a dose perspective, Pu-241 can be a controlling factor once it is present above a few percent in a mixture. For a 50% mixture of Pu-241 and Pu-240, the dose contribution from Pu-241 is a factor of 400 times that of the Pu-240 component. At 90% Pu-241, the contribution is a factor of 4,000. These values are even higher when the mixture contains Pu-239 instead of Pu-240. In order to use the available plutonium-239/240 data to calculate internal exposure to Pu-241, it would be necessary to know the ratio of Pu-241 to Pu-239/240 in the material to which a person was exposed. These data are not available to NIOSH. Due to the differences in specific activity mentioned above, application of a bounding ratio would result in an implausible exposure and would therefore not be sufficiently accurate. For these reasons, NIOSH has determined that it cannot determine internal exposure from Pu-241 for the period from January 1, 1954 through December 31, 1966.

6.1.3 Internal Feasibility Conclusions

NIOSH does not have access to sufficient employee monitoring, workplace monitoring, or source term data to estimate potential internal exposures to thorium and plutonium-241 during the period from January 1, 1958 through December 31, 1976 at the Y-12 Plant. Consequently, NIOSH finds that it is not feasible to estimate, with sufficient accuracy, internal exposures to thorium and plutonium-241 and resulting doses for the class of employees covered by this evaluation.

Although NIOSH found that it is not possible to completely reconstruct internal radiation doses for the period from January 1, 1958 through December 31, 1976, NIOSH intends to use any internal monitoring data that may become available for an individual claim (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures). Dose reconstructions for individuals employed at Y-12 during the period from January 1, 1958 through December 31, 1976, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

NIOSH is continuing to evaluate the period beginning January 1, 1977 to determine if thorium-related infeasibility issues continued beyond the recommended SEC class period of 1958-1976.

6.2 Feasibility of Estimating External Exposures

This evaluation responds to a petition based on NIOSH determining that internal radiation exposures to thorium and plutonium-241 could not be reconstructed for a dose reconstruction referred to NIOSH by the Department of Labor (DOL). As noted above, HHS will consider this determination to be sufficient without further consideration to determine that it is not feasible to estimate the levels of radiation doses of individual members of the class with sufficient accuracy. Consequently, it is not necessary for NIOSH to fully evaluate the feasibility of reconstructing external radiation exposures for the class of employees covered by this report.

In its previous SEC-00186 class designation, NIOSH found that it has access to sufficient employee monitoring data to bound potential external exposures for employees at Y-12 for a period from January 1948 through December 1957 (NIOSH, 2011). This current evaluation has found no evidence to the contrary for the period from January 1, 1958 through December 31, 1976. NIOSH has established that it has access to sufficient information to either: (1) estimate the maximum external radiation dose for every type of cancer for which radiation doses are reconstructed that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the external radiation doses to members of the class more precisely than a maximum dose estimate.

Adequate medical dose reconstruction is possible by using the assumptions described in the Y-12 Site Profile, Occupational Medical Dose (ORAUT-TKBS-0014-3).

6.3 Class Parameters Associated with Infeasibility

HHS has designated an SEC class associated with SEC-00186 for all Y-12 Plant workers for the period from January 1, 1948 through December 31, 1957 (HHS, 2011; NIOSH, 2011). The time period covering thorium operations under evaluation in this report is January 1, 1959 through December 31, 1976. The time period covering plutonium-241 operations in this report is January 1, 1954 through December 31, 1966. Considering the combination of the thorium and plutonium-241 time periods, and considering that there is already an SEC class for Y-12 covering all workers in all facilities through December 31, 1957, NIOSH recommends that this current class include the time period from January 1, 1958 through December 31, 1976. As discussed in Section 5.4.1, there are indications that isotopic-specific results (i.e., Ac-228 and Pb-212) might be available starting in 1977. NIOSH has not ascertained the availability of these data at this time; therefore, it will continue to evaluate the feasibility of internal dose reconstruction for thorium at the Y-12 site beginning January 1, 1977.

NIOSH has determined that, due to undocumented worker movements across the site, limited claimant-specific information pertaining to work locations, and a determination by the Department of Labor (DOL) that employment records do not indicate work locations, NIOSH is unable to eliminate any specific worker from potential exposure scenarios based on assigned work location. Accordingly, NIOSH is recommending that this class be established for all workers in all areas of the Y-12 site.

7.0 Summary of Feasibility Findings for Petition SEC-00251

This report evaluates the feasibility for completing dose reconstructions for employees at Y-12 from January 1, 1958 through December 31, 1976. NIOSH determined that members of this class may have received radiation exposures from thorium and plutonium-241. NIOSH lacks sufficient information, which includes biological monitoring data, sufficient air monitoring information, or sufficient process and radiological source information), that would allow it to estimate the potential internal exposure to which the proposed class may have been exposed.

NIOSH has documented herein that it cannot complete the dose reconstruction related to this petition. The basis of this finding demonstrates that NIOSH does not have access to sufficient information to estimate either the maximum radiation dose incurred by any member of the class or to estimate such radiation doses more precisely than a maximum dose estimate.

External radiation exposures can be adequately reconstructed for this class of Y-12 employees using ORAUT-TKBS-0014-6. Likewise, occupational medical doses and environmental doses can be reconstructed using ORAUT-TKBS-014-3 and ORAUT-TKBS-0014-4, respectively. Internal doses, with the exception of thorium and plutonium-241 (as described above), can be adequately reconstructed using ORAUT-TKBS-0014-5.

Although NIOSH found that it is not possible to completely reconstruct radiation doses for the proposed class, NIOSH intends to use any internal and external monitoring data that may become available for an individual claim (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures). Therefore, dose reconstructions for individuals employed at Y-12 during the period from January 1, 1958 through December 31, 1976, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

8.0 Evaluation of Health Endangerment for Petition SEC-00251

The health endangerment determination for the class of employees covered by this evaluation report is governed by EEOICPA and 42 C.F.R. § 83.14(b) and § 83.13(c)(3). Pursuant to these requirements, if it is not feasible to estimate with sufficient accuracy radiation doses for members of the class, NIOSH must determine that there is a reasonable likelihood that such radiation doses may have endangered the health of members of the class. The regulations require 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 employees 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 is aware of a nuclear criticality accident in Building 9212 of the Y-12 Plant on June 16, 1958. NIOSH has investigated the accident and has developed a roster of workers involved. NIOSH assigns radiation dose for the 1958 incident in accordance with ORAUT-OTIB-0057. NIOSH did not identify any evidence that would establish that any additional members of the class were exposed to radiation during the 1958 incident or during any other discrete incident likely to have involved levels of exposure similarly high to those occurring during nuclear criticality incidents. However, the evidence reviewed in this evaluation indicates that some employees in the class may have accumulated chronic radiation exposures through intakes of thorium (and associated progeny) and plutonium-241. Consequently, NIOSH is specifying that health was endangered for those employees covered by this evaluation who were employed for a number of work days aggregating at least 250 work days within the parameters established for this class or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

9.0 NIOSH-Proposed Class for Petition SEC-00251

This evaluation defines a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. This class includes all employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the Y-12 Plant in Oak Ridge, Tennessee, during the period from January 1, 1958 through December 31, 1976 for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort.

10.0 Evaluation of Second Similar Class

In accordance with § 83.14(a), NIOSH may establish a second class of co-workers at the facility, similar to the class defined in Section 9.0, for whom NIOSH believes that dose reconstruction may not be feasible, and for whom additional research and analyses is required. If a second class is identified, it would require additional research and analyses. Such a class would be addressed in a separate SEC evaluation rather than delay consideration of the current claim. At this time, NIOSH has not identified a second similar class of employees at the Y-12 Plant for whom dose reconstruction may not be feasible.

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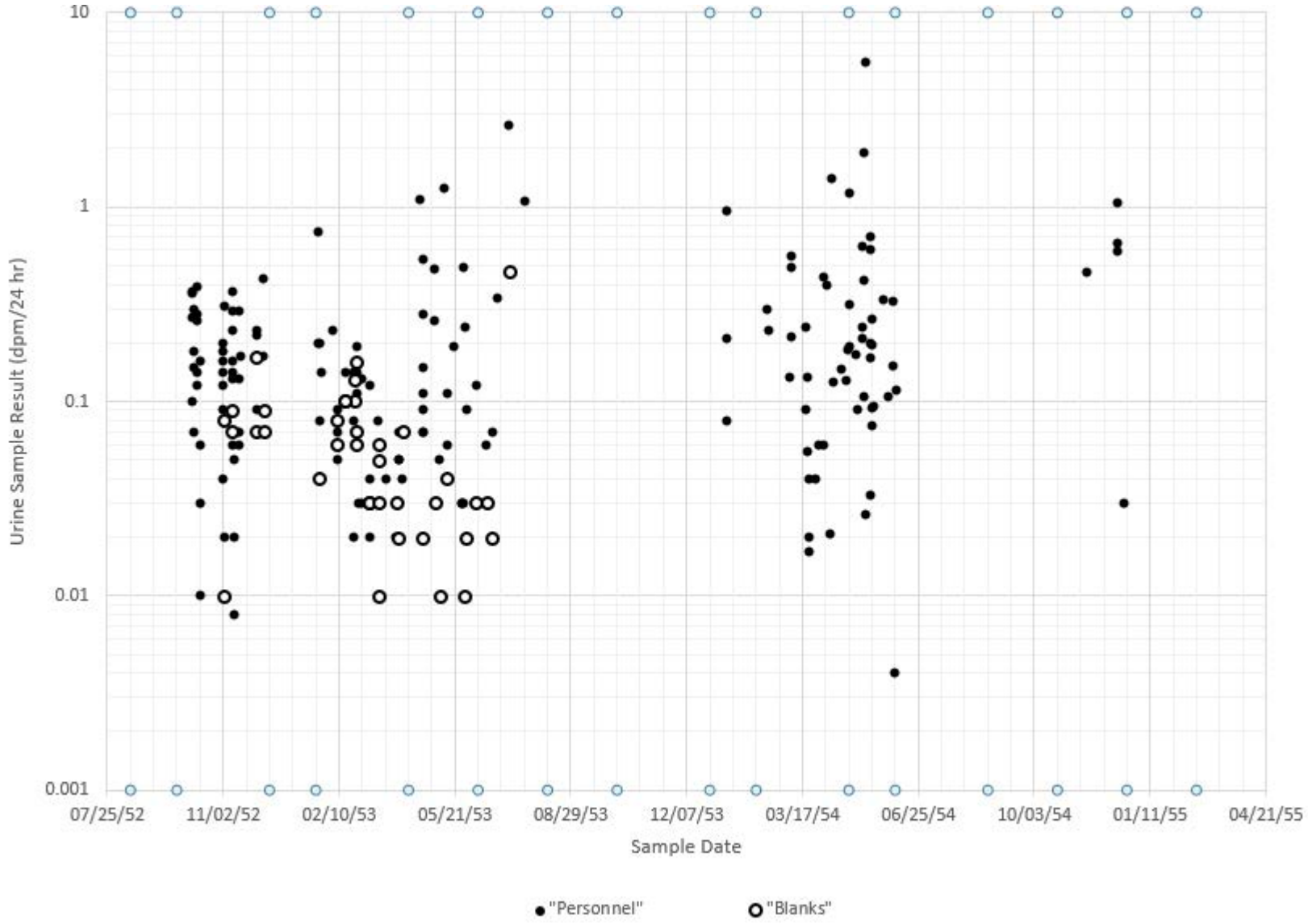
Attachment 1: Plutonium Bioassay Samples for 9204-3 Workers (1952-1954)

Name [redacted]	Oct 52	Nov 52	Dec 52	Jan 53	Feb 53	Mar 53	Apr 53	May 53	Jun 53	Jul 53	Jan 54	Feb 54	Mar 54	Apr 54	May 54	Jun 54	Nov 54	Dec 54	Total
A1-1	1	3	2	0	2	2	0	3	1	0	1	0	3	3	5	0	0	2	28
A1-2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
A1-3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
A1-4	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	0	0	4
A1-5	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	0	0	0	5
A1-6	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
A1-7	4	2	0	0	3	2	2	0	0	0	1	0	1	0	2	0	0	1	18
A1-8	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	1	0	0	4
A1-9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
A1-10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
A1-11	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	6
A1-12	0	2	1	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	6
A1-13	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
A1-14	1	0	0	0	0	0	2	1	0	0	0	0	0	0	0	1	0	0	5
A1-15	0	0	0	0	0	0	0	0	0	0	1	0	3	3	2	1	0	0	10
A1-16	3	3	0	2	0	1	0	0	1	0	0	1	3	3	3	0	0	0	20
A1-17	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	5
A1-18	2	3	2	0	2	5	1	5	3	2	0	0	0	0	0	0	1	0	26
A1-19	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	3
A1-20	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	4
A1-21	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	3
A1-22	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
A1-23	2	2	0	2	2	0	2	3	0	0	1	1	3	1	4	0	0	2	25
A1-24	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2
A1-25	0	4	4	2	9	7	5	6	4	1	0	0	0	0	0	0	0	0	42
Grand Total	**21**	**30**	**12**	**7**	**21**	**17**	**19**	**21**	**9**	**3**	**4**	**2**	**19**	**12**	**23**	**5**	**1**	**5**	**231**

Attachment 2: Plutonium Bioassay Sample Results for 9204-3 Workers (1952-1954)



Attachment 3: Plutonium Bioassay Samples for 9204-3 Workers (1965)

Name [redacted]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
A3-1	0	1	0	0	0	0	0	1	0	1	1	0	4
A3-2	1	1	0	1	1	0	2	2	1	1	0	0	10
A3-3	0	1	0	0	0	0	0	1	0	0	0	1	3
A3-4	2	1	0	0	0	2	1	2	0	1	1	1	11
A3-5	2	1	3	2	2	2	2	0	1	1	1	1	18
A3-6	2	0	1	0	1	0	0	1	1	1	1	0	8
A3-7	1	1	2	0	0	1	0	2	0	1	0	2	10
A3-8	0	1	0	1	0	0	0	1	0	3	3	0	9
A3-9	0	1	1	0	0	0	1	2	0	0	0	1	6
A3-10	0	2	2	1	4	5	4	2	2	3	3	2	30
A3-11	2	2	4	2	3	2	1	3	0	3	2	2	26
Grand Total	**10**	**12**	**13**	**7**	**11**	**12**	**11**	**17**	**5**	**15**	**12**	**10**	**135**

Attachment 4: Plutonium-241 Bioassay Samples for 9204-3 Workers (1967-1985)

Name [redacted]	1967	1968	1969	1970	1971	1972	1973	1974	1976	1977	1978	1979	1981	1982	1983	1984	1985	Total
A4-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	5
A4-2	1	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	5
A4-3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
A4-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	0	7
A4-5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
A4-6	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	2
A4-7	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	7
A4-8	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5
A4-9	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
A4-10	0	0	0	0	0	0	0	0	0	4	0	0	4	0	0	0	0	4
A4-11	8	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	11
A4-12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
A4-13	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
A4-14	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
A4-15	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	5
A4-16	1	0	0	0	0	0	0	0	0	0	12	1	0	0	0	0	0	14
A4-17	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
A4-18	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
A4-19	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
A4-20	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	5
A4-21	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
A4-22	0	0	0	0	0	2	5	0	0	0	0	0	0	0	0	0	0	7
A4-23	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
A4-24	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
A4-25	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	5
A4-26	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4

Name [redacted]	1967	1968	1969	1970	1971	1972	1973	1974	1976	1977	1978	1979	1981	1982	1983	1984	1985	Total
A4-27	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
A4-28	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
A4-29	7	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	11
A4-30	0	0	0	0	0	2	8	0	0	0	0	0	0	0	0	0	0	10
A4-31	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
A4-32	11	4	2	5	1	6	5	4	1	1	0	0	0	0	0	0	1	41
A4-33	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
A4-34	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
A4-35	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3
A4-36	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	3
A4-37	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3
A4-38	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	5
A4-39	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
A4-40	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
A4-41	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
A4-42	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
A4-43	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
A4-44	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	4
A4-45	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	4
Total	**74**	**6**	**3**	**6**	**2**	**24**	**35**	**4**	**1**	**16**	**28**	**1**	**8**	**1**	**5**	**7**	**1**	**222**

Attachment 5: Data Capture Synopsis

Table A1-1: Summary of Holdings in the SRDB for Y-12 Plant

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
Primary Site/Company Name: Y-12 Plant 1942-present, DOE Alternate Site Names: Y-12 National Security Complex Physical Size of the Site: 811 acres holding over 350 buildings. Site Population: In 1945, more than 22,000 workers at the site. During the Cold War 8,000 people worked around the clock. Noted 6,866 employees in June 1963 and 6,000 in 2011. In October 2018, Y-12 reported more than 4,700 federal and contractor employees work at the site.	Awaiting release of a Documented Communication from DOE Headquarters. Bioassay data, 86-inch cyclotron program and radiation protection, buildings and years where thorium was present, external exposure information, foundry health physics, handling and working with Np, in-vivo monitoring program and results, list of names and badge numbers, neutron field measurement, uranium air limits and their impact on Y-12, personnel notebooks, plant procedures, plutonium air problem, progress reports, radiation generating devices, radiation safety manual, radiological incidents, radiological surveys (airborne, contamination, etc.), record book of materials, run sheets from 86-inch cyclotron, separation of isotopes, neutron film results, sunflower foundry employees, thorium program lung count results, transuranic hazard assessment, uranium in effluent, urinalysis and fecal sample program related information, various technical basis documents, applying thorium surface contamination limits, internal dosimetry program, background subtraction and critical level for ET1 dosimeters, calibration factors, estimating the shallow dose equivalent using HBG element four readings, dosimetry quality control program information, building radiation and contamination periodic surveys, neutron-photon radiation surveys, container surveys for outgoing shipments, calibration and operation of the in-vivo lung counter, individual employee bioassay and film/TLD reports, plant health physics quarterly reports, thorium contamination survey results, thorium air sample results, air sampling system and locations, thorium fabrication, thorium machining, thorium processing, a process knowledge expert interview, data reduction software for in-vivo counting, dosimetry data with thorium in-vivo counts for a Y-12 employee, and a 1964 Y-12 radiation safety manual.	OPEN	799
State Contacted: Not Applicable	State was not contacted due to Y-12 being an active Department of Energy site.	Not Applicable	Not Applicable
Albany Research Center	A 1950 report on the chemical properties of californium.	03/02/2013	1

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
Ames Laboratory	Ames histories, 1951-1953 radiation work permits, survey reports, and thorium shipments to other facilities.	01/25/2016	8
Argonne National Laboratory-East	Organization of National Nucleonic Program, personnel procedure for transferring to Y-12 in 1943, and plutonium scrap processing information.	04/02/2008	4
Battelle National Laboratory-King Avenue	Thorium reports, a 1951 material balance report, and a nuclear battery report.	04/14/2011	5
Brookhaven National Laboratory	Ambient air monitoring parameters at DOE facilities and monthly reports.	10/22/2008	4
Cincinnati Public Library	A Manhattan Project History.	08/06/2008	1
Cincinnati Operations Center Library	Y-12 photographs and map key, urinalysis reports, an ORNL visitor guide, modifications to the ORNL Health Center, external exposure summaries 1989-1991, a DOELAP status report for the Centralized External Dosimetry System, a 1994 internal dosimetry review, the 1990 survey and characterization of Building 9201-2, a DOELAP reaccreditation application, the technical basis for augmenting the criticality alarm system, the air monitoring technical basis document, the DOE Office of Oversight Radiological Task Team reports, the survey and release protocol for wooden items, the implementing order for 10 CFR 835, and a survey and release plan for heavy equipment.	07/16/2018	16
Claimant Provided	Work products from inter-agency working groups and links between exposure to occupational hazards and illnesses in the DOE contractor workforce, an extrusion video, radon measurements, a site walking tour, a contamination survey and environmental report, and a hearing before the workers' compensation board state of New York.	12/27/2016	6
Colorado Mesa University	Recovery of uranium from carnotite ores, progress reports of carnotite studies, separation of uranium from urine, stack sampling, radiation emergencies, and new methods for interpreting neutron data from various dosimeter types.	10/16/2012	10
Curtiss-Wright	Shipping information and orders.	04/24/2009	1
Department of Labor / Paragon	Background report and evaluation of resurvey requirements for the former Atomic Energy Commission portion of the Lake Ontario Ordinance Works, request for scrap evaluation, shipment of Schenectady wastes to Oak Ridge, a complex-wide mixed waste report, a mercury waste management report, and a visit from Cotter Corporation personnel.	10/29/2014	12
DOE Albuquerque Complex NNSA	NURE activation analysis system correspondence.	01/13/2012	1
DOE Environmental Consolidated Business Center (EMCBC) - Denver	Rocky Flats thorium shipments to Y-12.	02/12/2014	1

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
DOE Environmental Information Center	Y-12's receipt of gold from the Paducah metals recovery program.	07/20/2011	1
DOE Germantown	Beryllium history, monthly accountability reports, thorium information, site history, Manhattan District History sections, records holding area search procedures, DOE reasonable search protocol spreadsheet, and a data tracking spreadsheet.	09/17/2015	17
DOE Legacy Management - Grand Junction Office	Accomplishments of the National Lead Company of Ohio, Electro Metallurgical weekly production report, requests for material transfers, storage/disposal requests, electromagnetic separation of isotopes at Oak Ridge, results of mobile gamma scanning activities, results of soil sample analysis, return of thorium from Savannah River programs, return of thorium from Davison Chemical, LOOW production report describing materials shipped to Y-12, budget reviews, an accidental radiation excursion at Y-12, a contractor list, and history of Hanford.	08/30/2011	51
DOE Legacy Management - Morgantown	Health and mortality studies of federal nuclear workers, uranium in urine samples, appraisal of occupational medical program, bioassay department highlights report, comparison of FMPC's uranium in urine sample results with Y-12's results, comprehensive epidemiologic data resource, DOE studies finding excess cancer mortality at several DOE nuclear facilities, disposal of thorium residues, Extrusion Plant (RMI) receipts and shipments, progress and production reports and orders, material balance report by facility, plutonium content of NLO feed materials, production order enriched uranium to Y-12, results of uranium urines, thorium shipments, thorium bioassay, recycled uranium data, trip reports, FUSRAP reports, environmental reports, and uranium urine exchange program information.	04/05/2016	156
DOE Legacy Management - MoundView (Fernald Holdings, includes Fernald Legal Database)	Air emissions annual report, annual report of the Health and Safety Division, Colonie site receipts of depleted uranium, DOE health and mortality study, environmental reports, Grand Junction processing of feed material scraps, incineration of radioactive solid wastes, major thorium campaigns and accountability documents, radioactive waste shipments, radiological incidents, shipping and receipt documents for enriched uranium and thorium, thorium bioassay investigations, thorium derby metal for Y-12, thorium nitrate specifications, trip reports, and Y-12 Plant thorium powder or pellet procurement specifications.	02/01/2012	79
DOE Legacy Management - MoundView (Fernald Holdings, includes Fernald Legal Database) / Albany Research Center	The 1958 symposium on uranium industry occupational health experiences.	09/30/2003	1

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
DOE Legacy Management - Westminster	Complex-wide external dosimetry technical basis document, plutonium/actinide recovery history, lifetime dose calculations from systemic burden and lung count data, technical services quarterly report, Elza Gate bioassays sampling logs, and reports of analysis.	01/14/2016	5
DOE Nuclear Materials Management and Safeguards System (NMMSS)	Material transfers between Y-12 and Rocky Flats.	07/10/2013	2
DOE Oak Ridge Operations	Material accountability reports, description of thorium processing, safety meetings, PCB meetings, bioassay results, external exposure results, TLD processing, fluorine control, artificial urine reports, asbestos worker files, the mobile body counter, U-233 history and inventories, trip reports, TLD problems, respiratory program occurrence report, periodic progress reports, and environmental reports.	01/13/2014	64
DOE Oak Ridge Operations Records Holding Task Group Vault	Building index, contamination control, discontinuation of DuPont film, employee work history records, external exposure reports, film badge program, foundry beta radiation control, health physics records, internal exposures at Y-12 , personnel participating in decontamination work, monthly health physics report, collection and recovery of airborne tuballoy, monthly production reports, production statistics and thorium inventories, radiological incidents, radiological surveys, reduction of radiation exposures, technical basis for beta skin dose calculations at the Y-12 plant, uranium dust concentrations, urinalysis and whole body count information, African Metals invoices, materials in 0101 area - Clinton Engineer Works, and the storage of U-235 from Los Alamos at Clinton Engineer Works.	08/14/2015	162
DOE Office of Scientific and Technical Information (OSTI)	Closed-cycle beta process, alpha II calutron development, uranium recovery by spray cleaning, thorium receipts, radiological surveys, pocket meter logbook notes, material transfers, coating of metallic thorium, material inventories, health physics logbooks, personnel monitoring, internal exposure study, applied health physics program review, calibrating and reading TLDs, periodic reports, and airborne uranium.	09/24/2018	85
East Tennessee Technology Park (ETTP)	Special form material procedures, health physics procedures, implementation plan for DOE Order 5480.11, the ETTP internal dosimetry program, technical basis, and evaluations, 10 CFR 835 implementing program documents, worker safety and health program documents, and Oak Ridge Reservation annual air emission reports.	01/11/2017	25

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
Environmental Measurements Laboratory (EML) Library	Air sampling for the control of internal exposure from enriched uranium at Y-12, a beryllium study, criticality alarms and accident dosimetry, and in-vivo counting as a device for evaluating uranium exposure.	01/21/2011	4
Federal Records Center - Atlanta	Uranium tolerances, finger film, biological research at Mound, tritium information, and an Oak Ridge Operations Office health protection status report.	08/12/2004	5
Federal Records Center - Boston	Personnel termination exposure summaries.	04/27/2012	1
Federal Records Center - Chicago	Contamination control limits, a tritium release limits position paper, radiological control manuals and technical bases.	06/20/2013	6
Federal Records Center - Dayton	Radiation dose determinations from indium foils in multi-plant security badges, limits for material from K-25 and Y-12 potentially contaminated with tritium, a Health Physics Division annual report, transfers of highly enriched uranium, a RCRA facility investigation, and dose estimates for a Y-12 incident.	06/02/2014	7
Federal Records Center - Denver	Mortality among radiation workers at a plutonium weapons facility, beryllium purchasing, fire protection workshop proceedings, a 1967 review of criticality accidents, and a listing of mixed waste streams.	01/25/2012	5
Federal Records Center - Kansas City	Reports of urinalysis with sample routing logs, Tiger Team findings, a 1990 TLD occupational exposure report, and the process for handling contaminated returns to the Kansas City Plant.	10/09/2013	5
Federal Records Center - Lee's Summit	DOE unusual incident reports, a volumetric release analysis, environment, safety, and health performance indicators, 1988 bioassay results, a West Valley fact book, and an analysis of Tiger Team findings.	05/17/2016	21
Federal Records Center - San Bruno	Beta run reports, personnel medical records handling, personnel assignment logs, schedule for track B, a personnel dosimetry intercomparison, medical and health physics quarterly reports, plutonium and fission products metabolism, and health chemistry accident reports.	02/12/2018	14
Fernald / SC&A	Mobile in-vivo radiation monitoring laboratory brochure.	06/26/2003	1
General Atomics	The 1958 criticality incident at Y-12.	08/16/2005	1
Goldberg, Persky, and White PC - Mancuso Collection	A 1973 contractor list, a records retention discussion, correspondence, and a local news article regarding a small fire in 1976.	01/10/2017	8
Hagley Museum & Library	General history of Clinton Engineer Works, race for the bomb, the Hanford story, and uranium experimental program on heat treatment.	09/29/2010	8

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
Hanford	In-vivo counting method for determining the uranium lung burden, annual and monthly progress reports, environmental monitoring and protection committee information, smelting uranium-contaminated ferrous metal scrap, production of tritium, health physicist reports, a waste water treatment review, inventories, material losses, uranium mass balance project document index and attachments, accountability reports, and accountability survey data.	03/20/2013	42
Idaho National Laboratory (INL)	Material transfers between Y-12 and INL facilities, handling of Y-12 material at INL, correspondence, visitor badge reports, criticality safety evaluations, a documented communication, a list of publications, and employee previous exposure histories.	03/16/2016	43
INL Electronic Document Management System (EDMS)	The results of an EDMS keyword search.	06/29/2016	1
Interlibrary Loan	Environmental levels of radioactivity at Atomic Energy Commission installations, work history reports for oxide conversion facility, proceedings of a short criticality safety course, the Seaborg journal, and the proceedings of an incineration conference.	05/29/2012	24
Internet - Defense Technical Information Center (DTIC)	An occupational dose reconstruction bibliography, uranium alloy metallurgy bibliography, defense nuclear facilities safety board reports to Congress, actinide research quarterly reports, physical metallurgy of uranium alloys, and the characterization of enriched uranium oxide particles.	06/05/2017	20
Internet - DOE Comprehensive Epidemiologic Data Resource (CEDR)	Health physics hygiene progress report and the impact of downsizing and reorganization on employee health and well-being at the DOE Y-12 Plant.	01/23/2010	3
Internet - DOE Health, Safety, and Security (HSS)	10 CFR 835 exemption requests.	02/07/2017	2
Internet - DOE Legacy Management	Preliminary survey of the Elza Gate warehouse area, removal of uranium from soil, beryllium-associated worker registries, annual occupational exposure reports, and a former worker medical screening report.	06/05/2017	10
Internet - DOE Legacy Management Considered Sites	A 1951 monthly progress report and a mixed waste inventory report.	04/24/2012	2
Internet - DOE National Nuclear Security Administration (NNSA) - Nevada Site Office	Babcock & Wilcox Technical Services cited for violation, the final Y-12 environmental impact statement, and Y-12 reducing its nuclear footprint.	11/16/2015	5
Internet - DOE Noncompliance Tracking System (NTS)	Noncompliance with Nevada Test Site waste acceptance criteria and a discussion of isolated non-uranium contamination areas.	10/04/2018	2
Internet - DOE Oak Ridge Operations	Release of a parcel of land to the city of Oak Ridge, the demolition of Building 3704, photographs of Building 9401-2, and the 2016 Oak Ridge Reservation annual environmental report.	05/01/2018	4

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
Internet - DOE Occurrence Processing and Reporting System (ORPS)	No thorium related reports were identified.	10/04/2018	0
Internet - DOE Office of Scientific and Technical Information (OSTI)	The 2006 Oak Ridge Reservation annual environmental report.	02/01/2015	1
Internet - DOE OpenNet	Criticality accident at the Y-12 Plant, declassification of the quantity of enriched lithium produced at Y-12, Manhattan District history, monthly status and progress reports, semiannual reports of the Atomic Energy Commission, operational accidents and radiation exposure experience, release of radioactivity to the environs request by AEC, uranium dust exposure and lung cancer risk in four uranium processing operations, trip reports, Oak Ridge Institute of Nuclear Studies medical research reports, a californium-252 report, fuel slug studies, Manhattan Project field progress reports, material transfers, a plant tour, National Radiobiology Project interviews, Massachusetts General Hospital uranium study, calculation of potential incident doses, radiobiology reports, and neutron exposure dosimetry by in-vivo sodium-24 measurements.	09/19/2016	144
Internet - DOE OSTI Energy Citations	Clean atmosphere approach to radiological decontamination of concrete surfaces, model for uranium lung clearance at the Y-12 Plant, Y-12 discharge of enriched uranium to the sanitary sewer, study of TLD beta calibration factor for exposure to depleted uranium, coaxial germanium detectors in the Y-12 in-vivo monitor, disposal of United Nuclear Company materials at the Y-12, environmental survey report, modeling of Elza Gate contaminated material, a Pinellas Plant feasibility study, a mathematical model for lung counting, the feasibility of in-vivo thorium measurements, ORNL Chemical Technology Division reports, a 2011 DOE occupational radiation exposure report, and a nuclear accident dosimetry intercomparison study.	08/01/2013	43

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
Internet - DOE OSTI Information Bridge	DOE Complex buried waste characterization assessment, Conversion and Blending Facility highly enriched uranium to low enriched uranium as uranium hexafluoride, disposition of highly enriched uranium obtained from the Republic of Kazakhstan environmental assessment, electromagnetically enriched isotopes inventory, environmental evaluation and reports, export license issued for DOE Oak Ridge for shipment of uranium-235, human radiation experiments, in-vitro data and comments, list of ERDA radioisotope customers, occupational dose reduction, post construction report for the United Nuclear Corporation disposal site, radiological risk assessment of a radioactively contaminated site, remedial investigation of Bear Creek Valley at the Oak Ridge Y-12 Plant, sampling approach for characterization of the Scarboro community, testing of the Y-12 Plant criticality accident alarm system detectors at the Sandia Pulsed Reactor Facility, metal fabrication program for the Clinton Engineering Works and the Hanford Engineering Works including the dummy slug program, waste vitrification projects, Y-12 salvage yard scrap metal characterization study, Y-12 Plant solid waste management system, a beryllium exposure assessment, a uranium hydride report, and hazardous and mixed waste generation.	08/20/2013	163
Internet - DOE OSTI SciTech Connect	High-level radioactive waste reports, low-level radioactive waste reports, spent nuclear fuel strategic plans, spent fuel storage, environmental reports, groundwater protection and quality reports, waste generation and pollution prevention reports, a tank characterization survey, a Y-12 Tiger Team assessment, dosimetry quality assurance, the status of environmental initiatives, periodic project reports, life cycle analysis approach to D&D projects, strategic special nuclear material inventory differences, and an Oak Ridge dose reconstruction report.	12/18/2017	100
Internet - Energy Employees Claimant Assistance Project (EECAP)	A RCRA landfill analysis for the United Nuclear Corporation disposal site, assessment of enriched uranium storage safety issues, Development Division periodic reports, operation of the chip oxidation facility, uranium removal from contaminated soils, and reduction of airborne radioactivity levels at the Building 9201-5 arc melt sawing operation.	03/26/2014	13

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
Internet - Google	Accountability and control of sealed radioactive sources, annual site environmental reports, Clinton Engineer Works photos, Clinton Laboratory expands to Y-12 buildings, depleted uranium operations at Y-12, division progress reports, Eastman at Oak Ridge during World War II, environment monitoring assessment and reports, epidemiological studies, evaluation of iodine-131 releases, historical evaluation of the film badge dosimetry program at Y-12, liquid waste disposal at Oak Ridge National Laboratory, major relocation of highly enriched uranium completed at Y-12, Manhattan Engineer District history, neutron and gamma dosimeter intercomparison study, Oak Ridge, Tennessee, warehouses site fact sheet, operating Oak Ridge's calutrons, radiological incidents, Site X, Oak Ridge, Tennessee (map), status of highly enriched uranium processing capability at Y-12 building 9212, study of metal hydrides, Oak Ridge 86-inch cyclotron, urine bioassay program, personal air sampling (PAS) data in the internal dosimetry program, Y-12 history and fact sheet, environmental restoration, DOE occupational radiation exposure reports, characterization of contaminated scrap metal, oral history interviews, transuranic waste management, the characterization strategy for Building 9201-5, contractor performance evaluation reports, and the determination of thorium in thorium metal.	04/24/2018	494
Internet - Hanford Declassified Document Retrieval System (DDRS)	Fourth Atomic Energy Commission Air Cleaning Conference, specifications for Savannah River Site slugs, periodic department reports, a trip report, and a shipment of uranium rods to Y-12.	09/22/2015	7
Internet - Hathitrust	A 1962 dosimetry badge orientation experiment.	10/21/2015	1
Internet - Health Physics Journal	Identification of Oak Ridge Reservation emission sources, a urinalysis intercomparison study, an analysis of cesium body burdens, the retention of uranium in the chest, and radioactivity distributions in the metallurgical processing of thorium.	03/13/2017	6
Internet - Idaho National Laboratory (INL)	Shipments of purified uranium powder to Oak Ridge.	07/13/2016	3
Internet - International Atomic Energy Agency (IAEA)	The status of stable isotope enrichment and services.	12/19/2016	1
Internet - Journal of Occupational and Environmental Hygiene	No relevant documents identified.	10/08/2018	0
Internet - National Academies Press	Complex-wide safety and health management, research opportunities in D&D projects, Dr. Frank Spedding biographical memoirs, and radioactive waste reports.	03/17/2015	5

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
Internet - National Environmental Publications Information System (NEPIS, US EPA)	Environmental radiation data, environmental cleanup standards and regulations, transuranium elements dose limits and radiation protection, Y-12 records of decision, and an overview of waste solidification and stabilization at Superfund sites.	02/09/2016	15
Internet - National Institute for Occupational Safety and Health (NIOSH)	Special exposure cohort petition evaluation reports, NIOSH residual radioactive and beryllium contamination reports, designation of additional members of the SEC, the minutes of a Fernald Work Group meeting, and an Advisory Board on Radiation and Worker Health review of the Y-12 site profile.	06/29/2018	23
Internet - National Technical Information Service (NTIS)	Feasibility study of the correlation of lifetime health and mortality experience of AEC and AEC contractor employees' progress reports.	08/21/2006	2
Internet - Nuclear Regulatory Commission (NRC) Agencywide Document Access and Management (ADAMS)	DOE inventory report, evaluation of the potential for recycling of scrap metals from nuclear facilities, feasibility study for the United Nuclear Corporation disposal site at the Oak Ridge Y-12, integrated database U.S. spent fuel and radioactive waste inventories, projections, and characteristics, a soil management plan for the Oak Ridge Y-12, disposition of surplus highly enriched uranium, environmental impact statements, a Y-12 safety analysis report, advance notifications of shipments, facility hazard assessments, export licenses and shipments, NRC export license applications, and a 60-day notification of a materials transfer incident.	10/08/2015	130
Internet - Oak Ridge National Laboratory (ORNL)	ORNL Division and Laboratory periodic reports mentioning Y-12, radiation safety for Y-12 Building 9204-3 isotope separation operations, report on a calutron ion source, the recovery of uranium from acid liquors, a 1979 thorium utilization progress report, and Oak Ridge Reservation annual environmental reports.	09/26/2017	163
Internet - US Army Corps of Engineers (USACE)	The 2016 Formerly Utilized Sites Remedial Action Program (FUSRAP) update.	05/17/2018	1
Internet - Washington State University (U.S. Transuranium and Uranium Registries)	No relevant documents identified.	09/16/2015	0
Internet - Y-12	Y-12 anecdotes including one on thorium production.	08/01/2018	1
Iowa State University Library	An interview with Dr. Frank Spedding.	09/18/2013	1
Iron Mountain Storage Facility, Cranberry, PA	Survey of control over source and special nuclear materials national distillers and chemicals corporation.	09/11/2006	1
Kansas City Plant	Statement of Dr. Victor H. Reis before the subcommittee on Military Procurement Committee on National Security, US House of Representatives, radiological incidents, receipt of potentially contaminated parts, radiological surveys and air samples, operations reports, and dosimetry services.	10/01/2004	21

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
Kansas City Plant / SC&A	Notes from the review of Kansas City Plant classified documents.	08/16/2013	1
Lawrence Berkeley National Laboratory (LBNL)	Laboratory contracts 1948.	02/06/2007	1
Lawrence Livermore National Laboratory (LLNL)	Project Pluto meeting minutes, a glove box incident report, determinations of possible excursion yields and exposure rates, feasibility of liquid material transfers, and the Rocky Flats body counter.	11/16/2017	9
Los Alamos National Laboratory (LANL)	Excursions at the Oak Ridge criticality experiments facility, nonnuclear consolidation environmental assessment, polonium contamination at Pajarito, low-level mixed waste streams for the DOE Complex, corrected information on a plutonium shipment, decontaminating plutonium from oralloy parts for Y-12, and radioactive waste disposal and related issues.	01/16/2018	9
Los Alamos National Laboratory (LANL) - LAHDRA	Polonium contamination at Pajarito, waste minimization at a plutonium processing facility, a low-level complex-wide mixed waste report, and an environmental impact statement for the storage and disposition of weapons-usable fissile material.	12/12/2007	4
Mel Chew & Associates	A 1994 radiation exposure summary, laboratory procedures for thorium analyses, individual and group exposure histories, fecal uranium measurements, the uranium in urine program, recycled uranium data spreadsheets, and plutonium urine results.	12/14/2014	61
Metals & Controls Corp	Analysis of possible nuclear material losses and possible liabilities associated with present fuel manufacturing.	08/24/2004	1
MJW	Proceedings of a short nuclear criticality safety course.	10/16/2003	1
Mound Museum	Disposition of depleted salvage material, exposure to polonium from a neutron source, fabrication of weapon components, a shipment of irradiated bismuth slugs, polonium characteristic X-rays, polonium hazards, and correspondence concerning a lithium compound.	05/18/2010	12
National Archives and Records Administration (NARA) - Atlanta	AEC handbook on Oak Ridge operations, annual health protection review, bioassay results and procedures, calutron beam study, control of radiation hazards by Carbide and Carbon Chemicals Division, environmental data, equipment numbering system, film badge program description, hazards of piles at Y-12, monthly accountability reports, organization charts, personnel exposure data, progress reports, radiological and criticality incidents, radiological surveys, report of annual health protection review - New Brunswick Lab, reports of destruction of classified material, radiochemistry reports, shipments from Metal Hydrides to AEC facilities, shipping receipts, work done at Iowa State College, and handling fissionable material.	12/10/2010	135

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
National Archives and Records Administration (NARA) - Atlanta / SC&A	Decontamination of gloves.	09/26/2003	1
National Archives and Records Administration (NARA) - Chicago	Fuel preparation for the ZPR-III Reactor.	06/12/2015	1
National Archives and Records Administration (NARA) - College Park	Meteorological conditions, machining of uranium metal, accountability reports, thorium reports, researcher notes, Manhattan District history sections, and monthly status and progress reports.	03/11/2014	21
National Archives and Records Administration (NARA) - Kansas City	Historical information from property insurance association on Niagara Falls Storage Site / African Metals leased areas and a survey of the Nuclear Chemicals and Metals Facility before and after a shipment to Y-12.	06/24/2005	2
National Archives and Records Administration (NARA) - Seattle	Material transfers and a continuous air monitor calibration.	08/23/2017	5
Nevada Test Site (NTS)	The Y-12 electron beam welder and shipment of reactor fuel and waste from NTS to Y-12.	04/14/2008	2
New York State Archives	A Manhattan District history section and waste disposal at Lake Ontario Ordnance Works.	03/19/2012	2
New York State Department of Environmental Conservation	Recovery of uranium from Sylvania scrap and material transfers under contract no. AT(40-1).	07/31/2008	2
NIOSH	Production and use of recycled uranium, audit report confirmatory bioassay testing at selected sites, highly enriched uranium safety and health vulnerabilities associated with storage of highly enriched uranium, Los Alamos Scientific Laboratory information, nondestructive testing of uranium, radioactive waste shipment, recycled uranium mass balance project, history of the Oak Ridge National Laboratory's first 25 years, strikes at Y-12, the evaluation of health physics problems in thorium processing, trip reports, AEC reports to Congress, documented communications, and worker outreach meeting minutes.	08/27/2014	53
NIOSH - Health Related Energy Research Branch (HERB) Library	Oxide conversion facility work history reports.	09/08/2003	1
NIOSH / SC&A	BWXT-ORAU correspondence 2003-2005, recycled uranium project report, highly enriched uranium working group reports, Np237-U238 alloy radiation safety requirements, remarks on personnel monitoring at Y-12, technical basis document for the internal dosimetry program at Y-12, uranium urinalysis program, and Y-12 complex description.	02/05/2009	16
NIOSH OCAS Claims Tracking System (NOCTS)	A 1957 special separations logbook and a log entry regarding an Am-241 lung burden.	10/16/2018	2

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
Nuclear Regulatory Commission (NRC) Public Document Room	A trip report, the sixth intercomparison of nuclear accident dosimeters, the draft environmental assessment for treatment of low-level and mixed waste, in-vivo counts for two Kerr-McGee employees involved in a thorium explosion, and references to Y-12 in a NUMEC license renewal application.	08/15/2017	5
Oak Ridge Associated Universities (ORAU)	Brief history of the Y-12 external monitoring program, correction factors for film badge data, dosimetry records and radiation hazards questionnaire, film badge data, names of persons having dosimetry information, radiation dosimetry for epidemiologic lung cancer study, history of buildings at Y-12, and information on the calutron program for uranium enrichment.	01/15/2009	12
Oak Ridge Gaseous Diffusion Plant (K-25)	Internal dosimetry program technical basis documents and revisions, radiation protection training, personnel historical radiation exposure at Y-12, uranium salvage procedure, and procedure manual for production plants.	10/05/2016	18
Oak Ridge Institute for Science and Education (ORISE)	Data collection and validation for the Oak Ridge nuclear facilities mortality study.	06/11/2003	1
Oak Ridge Library for Dose Reconstruction	Status report on Clinch River study, high-flux isotope reactor description, engineering development of hydraulic fracturing as a method for permanent disposal of radioactive wastes, contaminant releases, uranium releases, annual applied health physics reports, environmental levels of radioactivity, aerial radiological surveys, annual environmental reports, waste disposal reports, recovery of uranium from fiberglass air filters, incident reports, historical uranium releases, fallout measurements, material accountability reports, stack sampling, facility and department periodic reports, analysis of the 1989 UF6 release, and worker mortality rates.	08/15/2011	298

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
Oak Ridge National Laboratory (X-10)	Radiological incidents, history of the Analytical Chemistry Division of Oak Ridge National Laboratory, Aircraft Nuclear Propulsion Project progress report, cyclotron operations, electromagnetic isotope separations, evaluation of neutron dosimetry, exposures received from typical diagnostic X-ray examinations at ORNL, health physics instrument manual, neutron dosimetry with the ORNL badge, Oak Ridge 86-inch cyclotron, X-ray facility reviews, production of radioisotopes in the ORNL 86-inch cyclotron, quarterly progress report, radiation safety manual, stable isotope separation in calutrons, technical basis for nuclear accident dosimetry, inventory of electromagnetically enriched isotopes, X-10 medical X-ray compliance survey, Y-12 film monitoring program, releases of thorium in Building 9204-1, 86-inch cyclotron target ruptures, area, equipment, and personnel contamination occurrence reports, periodic ORNL Division reports including material accountability, isotopic power materials, isotopes development center, and operations and individual dosimetry records.	09/03/2015	286
ORAU Team	Accounting for incomplete personal monitoring data on penetrating gamma doses, exposure matrix for the Mallinckrodt Chemical Company, effect of threshold energy and angular response of NTA film on missed neutron dose at Y-12, annual report radiation exposures for DOE and contractor employees, radiological incidents, external radiation monitoring at Y-12, health and mortality among contractor employees at DOE facilities, history and evaluation of the film badge dosimetry program at Y-12, potential missed dose to nuclear weapons assemblers, specific tables of isotopic production, Tiger Team assessment of the Pantex Plant, Y-12 exposure database, analysis of electronic personnel exposure data from Y-12, documented communications, technical basis documents, technical information bulletins, thorium air sample data spreadsheet, Y-12 quarterly health physics reports, in-vivo input and output radiation monitoring reports, quarterly health physics and industrial hygiene reports, annual body counter reports, and an example of actinium and lead body counting reporting.	08/16/2018	249

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
Paducah Gaseous Diffusion Plant	Alpha hazards from neptunium, computer program for whole body count, disposal of stored "tru" waste, environmental assessments and reports, estimates of transuranium alpha fed to Paducah cascade, exposure assessments, health protection information on uranium metal, in-vivo monitoring results, inventory of radioactivity released to environment, land burial of radioactive waste at the Paducah Plant, licensing of byproduct material, neptunium and plutonium plant material balance, dust studies, radiation protection program, radioactive contaminants in Paducah scrap, radioactive effluent release, monitoring and control, radioactive waste management, radiological incidents, study of plutonium and fission products, Paducah information, technical basis for the Centralized External Dosimetry System, trip reports, waste disposal criteria, and Y-12 TLD results that include Paducah area dosimeters.	10/06/2006	13
Pantex	Monitoring procedures for items received at Pantex.	07/19/2011	1
Portsmouth Gaseous Diffusion Plant	Eighth Analytical Services Forum Paducah Gaseous Diffusion Plant, the transfer of enriched uranium, and the neutron threshold detection project.	01/30/2013	3
Reactive Metals, Inc. (RMI)	Historic radionuclide releases from Oak Ridge Operations facilities.	08/17/2006	1
Rocky Flats Environmental Technology Site (RFETS)	The flammability and explosion potential of transuranic waste and audit responses.	08/31/2012	2
Sandia National Laboratories-Albuquerque	Technical basis for workplace air monitoring of airborne radioactive material at Y-12, Ross Aviation shipment surveys and documents, the 1991-1993 ORNL bioassay QC program, Webdose database external doses 2006-2008, and approval of the revised Radiological Control Manual.	09/09/2014	7
Savannah River Site (SRS)	Dosimetry visitors cards, radiation survey log sheets, a trip report, material transfers, SRS monthly reports, the thoria fuel irradiation program, and laboratory fume hood minimum acceptable face velocities.	06/07/2016	12
S. Cohen & Associates (SC&A)	Assessment for acceptance of enriched uranium at Y-12, radiation worker health at Y-12, Oak Ridge reservation annual site environmental report, photographic film as a pocket radiation dosimeter, recycled uranium mass balance project information, a trip report, criteria for acceptance of enriched uranium at Y-12, incident reports, unclassified thorium documents, special nuclear material licensing, and documented communications.	04/26/2011	18
SC&A / Atlanta NARA	Thorium metal processes.	09/26/2003	1

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
SC&A / Idaho National Laboratory	Environmental report, airborne radionuclide waste management information, a mercury shipment, a survey of waste management practices, and Idaho Chemical Processing Plant periodic reports.	06/24/2010	13
SC&A / NIOSH	The generation and flow of recycled uranium.	08/14/2003	1
SC&A / Y-12	Mobile lung counter data and fires and explosives investigations.	07/28/2010	2
Science Applications International Corporation (SAIC)	Annual summaries of whole body radiation exposures to external penetrating radiation.	09/02/2004	9
Southern Illinois University	Nuclear fuel fabrication, Oak Ridge site description, observations on uranium exposures, and visit requests.	10/29/2008	7
University of Colorado Norlin Library	A formal safety program cost/benefit study.	04/10/2006	1
University of Rochester Radiation Safety Office	Return of uranium peroxide to Oak Ridge.	08/20/2008	1
University of Tennessee Library	Creation of Clinton Engineer Works, a health physics report, health physics and exposure records, a calutron newspaper article, personnel monitoring records, the Biology Division Hot Laboratory, the decontamination of Building 9204-1, burial of Y-12 wastes, and a survey of Building 9206.	10/11/2011	14
Unknown	Annual radiation dose reports, annual environmental reports, designation of race tracks by number Y-12 and extension, dosimeter response characterization, estimation of radiation doses to the lungs of early uranium workers, excretion of uranium from mixed exposures under industrial conditions, fifth semiannual report of the atomic energy commission, flow of materials through the nuclear weapons complex, glossary of Y-12 coded terminology, health physics survey instruments used at Clinton, in-vivo method to determine uranium lung burden, Mallinckrodt Plant inspections, miscellaneous Fernald documents, monthly status and progress reports, neutron dose equivalent and energy spectra measurements at ORNL and Y-12, overview of the history of Y-12, protective equipment evaluation, radiation safety manual, radiological incidents, radiological surveys, relationship between in-vivo and urinalysis data collected, Rocky Flats site history, Simonds Saw & Steel material balance report, Westinghouse Nuclear Fuels Division and Westinghouse Atomic Power Development information, and X-ray radiation measurements in calutron cubicles.	02/10/2011	215
Unknown / SC&A	Y-12 references in Linking Legacies and a DOE indoor radon study.	10/09/2003	2
Unknown / Y-12	Neutron dosimetry response characterization and a Y-12 outdoor scoping survey.	06/10/2004	2

Data Capture Information	General Description of Documents Captured	Date Completed	Number Uploaded to SRDB
United States Enrichment Corporation (USEC)	A 1977 radiation termination report, the ERDAM 0525 annual occupational exposure reporting form, and a US Navy report on radioactive wastes.	10/06/2006	3
Weldon Spring	Analysis of long term data on uranium in air.	11/29/2004	1
Westinghouse Site (MO)	Accidental radiation excursion at Y-12, estimated lung exposure, in-vivo count results, and procedures and assignments for restricted personnel.	04/09/2009	7
Y-12 / ORNL	Plutonium urinalysis results, health physics reports for buildings and departments, polonium urinalysis reports, uranium and plutonium urinalysis reports, individual employee bioassay reports, tritium urinalysis reports, Building 9805-1 tritium reports, and high dose investigation reports.	05/14/2012	218
Y-12 / ORNL / Mel Chew & Associates	Participants in the tritium urine program 1956.	05/14/2012	3
Y-12 / ORNL / ORAU Team	August 1956 tritium report.	05/12/2012	1
Y-12 / SC&A	Medical examination reports, occupational medical review reports, environmental pollution and control data, radiation exposure data, and Y-12 specifications for recycle material receipts.	07/28/2010	5
TOTAL	Not Applicable	Not Applicable	**4,874**

Table A1-2: Database Searches for Y-12 Plant

Database / Source	Keywords / Phrases	Hits	Selected
Defense Technical Information Center (DTIC) COMPLETED 11/17/2015	Database search terms and Internet URL are available in the Excel file called “Y-12 Rev 01, (83.14) 10-26-18.”	13,000	2
DOE Hanford Declassified Document Retrieval System (DDRS) and Public Reading Room COMPLETED 09/22/2015	Database search terms and Internet URL are available in the Excel file called “Y-12 Rev 01, (83.14) 10-26-18.”	4	1
DOE Legacy Management Considered Sites COMPLETED 09/16/2015	Database search terms and Internet URL are available in the Excel file called “Y-12 Rev 01, (83.14) 10-26-18.”	0	0
DOE National Nuclear Security Administration (NNSA) - Nevada Site Office COMPLETED 11/16/2015	Database search terms and Internet URL are available in the Excel file called “Y-12 Rev 01, (83.14) 10-26-18.”	516	4

Database / Source	Keywords / Phrases	Hits	Selected
DOE Noncompliance Tracking System COMPLETED 10/04/2018	Database search terms and Internet URL are available in the Excel file called "Y-12 Rev 01, (83.14) 10-26-18."	158	1
DOE Occurrence Reporting and Processing System COMPLETED 10/04/2018	Database search terms and Internet URL are available in the Excel file called "Y-12 Rev 01, (83.14) 10-26-18."	817	0
DOE OpenNet COMPLETED 09/29/2015	Database search terms and Internet URL are available in the Excel file called "Y-12 Rev 01, (83.14) 10-26-18."	860	129
DOE OSTI SciTech Connect COMPLETED 09/21/2015	Database search terms and Internet URL are available in the Excel file called "Y-12 Rev 01, (83.14) 10-26-18."	351,967	48
Energy Employees Claimant Assistance Project (EECAP) COMPLETED 10/19/2015	Database search terms and Internet URL are available in the Excel file called "Y-12 Rev 01, (83.14) 10-26-18."	0	0
Google COMPLETED 10/08/2015	Database search terms and Internet URL are available in the Excel file called "Y-12 Rev 01, (83.14) 10-26-18."	4,728,957,100	35
Health Physics Journal COMPLETED 11/17/2015	Database search terms and Internet URL are available in the Excel file called "Y-12 Rev 01, (83.14) 10-26-18."	1,640	3
Journal of Occupational and Environmental Hygiene COMPLETED 10/19/2015	Database search terms and Internet URL are available in the Excel file called "Y-12 Rev 01, (83.14) 10-26-18."	20	0
National Academies Press COMPLETED 09/16/2015	Database search terms and Internet URL are available in the Excel file called "Y-12 Rev 01, (83.14) 10-26-18."	6,259	0
National Service Center for Environmental Publications (NEPIS) COMPLETED 09/21/2015	Database search terms and Internet URL are available in the Excel file called "Y-12 Rev 01, (83.14) 10-26-18."	248	14
NRC ADAMS Reading Room COMPLETED 10/08/2015	Database search terms and Internet URL are available in the Excel file called "Y-12 Rev 01, (83.14) 10-26-18."	1,000	83
United States Army Corps of Engineers (USACE) COMPLETED 09/16/2015	Database search terms and Internet URL are available in the Excel file called "Y-12 Rev 01, (83.14) 10-26-18."	4	0
U.S. Transuranium & Uranium Registries COMPLETED 09/16/2015	Database search terms and Internet URL are available in the Excel file called "Y-12 Rev 01, (83.14) 10-26-18."	23	0