SEC Petition Evaluation Report
Petition SEC-00217

Report Rev #:0 Report Submittal Date: April 14, 2015

Subject Expert(s):	Pat McCloskey
Site Expert(s):	N/A

Petition Administrative Summary

Petition Under Evaluation

Petition #	Petition Type	Petition Receipt Date	Qualification Date	DOE/AWE Facility Name
SEC-00217	83.13	June 12, 2014	January 8, 2015	Westinghouse Electric Corp. (New Jersey)

Petitioner-Requested Class Definition

All Atomic Weapons Employer employees who worked at any plant production area of Westinghouse Electric Corporation in Bloomfield, New Jersey, from January 1, 1950 through March 1, 2011.

Class Evaluated by NIOSH

All employees who worked in any plant production area of the Westinghouse Electric Corp. (New Jersey) site in Bloomfield, New Jersey, during the period from January 1, 1950 through March 1, 2011.

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

All Atomic Weapons Employees who worked at the facility owned by Westinghouse Electric Corp. (New Jersey) in Bloomfield, New Jersey, during the period from February 1, 1958 through May 31, 1958, or during the period from June 1, 1959 through June 30. 1959, 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 included in the Special Exposure Cohort.

Related Petition Summary Information

SEC Petition Tracking #(s)	Petition Type	DOE/AWE Facility Name	Petition Status
SEC-00159	83.14	Westinghouse Electric Corp., Bloomfield, New Jersey	Class added to the SEC for August 13, 1942 through December 31, 1949

Related Evaluation Report Information

Report Title	DOE/AWE Facility Name
SEC Petition Evaluation Report for Petition SEC-00159	Westinghouse Electric Corp., Bloomfield, New Jersey

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Evaluation Report Summary: SEC-00217, Westinghouse Electric Corp. (New Jersey)

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

Petitioner-Requested Class Definition

Petition SEC-00217 was received on June 12, 2014, and qualified on January 8, 2015. The petitioner requested that NIOSH consider the following class: *All Atomic Weapons Employer employees who worked at any plant production area of Westinghouse Electric Corporation in Bloomfield, New Jersey from January 1, 1950 through March 1, 2011.*

Class Evaluated by NIOSH

Based on its preliminary research, NIOSH accepted the petitioner-requested class. NIOSH evaluated the following class: All employees who worked in any plant production area of the Westinghouse Electric Corp. (New Jersey) site in Bloomfield, New Jersey, during the period from January 1, 1950 through March 1, 2011.

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

Based on its full research of the class under evaluation, NIOSH has defined two periods during which NIOSH cannot estimate radiation doses with sufficient accuracy. The NIOSH-proposed class includes: All Atomic Weapons Employees who worked at the facility owned by Westinghouse Electric Corp. (New Jersey) in Bloomfield, New Jersey, during the period from February 1, 1958 through May 31, 1958, or during the period from June 1, 1959 through June 30. 1959, 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 included in the Special Exposure Cohort.

The class under evaluation was reduced (see Section 3.0 below) because, based on its analysis of available resources, NIOSH found it could estimate radiation doses with sufficient accuracy for the following parts of the class under evaluation: January 1, 1950 through January 31, 1958; June 1, 1958 through May 31, 1959; and July 1, 1959 through April 30, 2000. Based on the sum of information from available resources, NIOSH's evaluation determined that April 30, 2000, was the last date for applicable EEOICPA program exposures at Westinghouse Electric Corp. (New Jersey).

Feasibility of Dose Reconstruction

NIOSH reviewed the AWE, commercial, and decommissioning and decontamination (D&D) activities at Westinghouse Electric Corp. (New Jersey) and has an understanding of the AWE and D&D operations. However, NIOSH does not have a sufficient understanding of Westinghouse Electric

Corporation's uranium and thorium commercial radiological activities that were performed concurrently with AWE operations. NIOSH interviewed former WEC employees and representatives and asked specifically about monitoring records for commercial operations, and has located only limited source term information to date, with no information regarding exposure conditions during commercial uranium and thorium operations. Radiation doses from commercial operations are required to be assessed during the site AWE operations periods. For this reason, NIOSH finds it is not feasible to estimate internal and external exposures with sufficient accuracy for all workers at the site during the AWE periods from February 1, 1958 through May 31, 1958, or from June 1, 1959 through June 30. 1959. With the exception of this class, per EEOICPA and 42 C.F.R. § 83.13(c)(1), NIOSH has established that it has access to sufficient information to: (1) estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred in plausible circumstances by any member of the class; or (2) estimate radiation doses more precisely than an estimate of maximum dose. Information available from additional resources is sufficient to document or estimate the maximum internal and external potential exposure to members of the evaluated class under plausible circumstances during the specified periods (January 1, 1950 through January 31, 1958; June 1, 1958 through May 31, 1959; and July 1, 1959 through April 30, 2000).

NIOSH finds that it is likely feasible to reconstruct occupational medical dose for Westinghouse Electric Corp. (New Jersey) workers with sufficient accuracy.

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

- Principal sources of internal and external radiation for members of the proposed class, during the two AWE periods, included exposures to: uranium and thorium utilized in site commercial operations; uranium metal and contamination during AWE-related rolling operations; and residual uranium and thorium contamination from previous AWE operations during the 1943-1949 period.

- Information obtained by NIOSH as part of this evaluation indicated that Westinghouse Electric Corp. conducted two AWE-related uranium machining campaigns for Fernald during the periods of May 12, 1958 through May 16, 1958, and June 25, 1959 through June 29, 1959. DOL revised the facility designation to include AWE operations during February-May 1958 and June 1959.

- NIOSH reviewed the AWE, commercial, and remediation activities at Westinghouse Electric Corp. and has an understanding of the AWE and remediation operations. However, NIOSH does not have a sufficient understanding of the uranium and thorium commercial radiological activities that were performed concurrently with AWE operations. NIOSH has been unable to locate internal or external monitoring data related to site commercial operations during the period from January 1, 1950 through April 30, 2000, including the two AWE operations periods.

- Radiation doses from commercial operations are required to be assessed during the site AWE operations periods. In the absence of available personnel and workplace monitoring data for commercial operations, NIOSH finds it is not feasible to estimate internal or external exposures with sufficient accuracy for all workers at the Westinghouse Electric Corp. (New Jersey) site during the period from February 1, 1958 through May 31, 1958, or during the period from June 1, 1959 through June 30, 1959.

- 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 Westinghouse Electric Corp. (New Jersey) during the periods from February 1, 1958 through May 31, 1958, and June 1, 1959 through June 30. 1959, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

Health Endangerment Determination

Per EEOICPA and 42 C.F.R. § 83.13(c)(3), a health endangerment determination is required because NIOSH has determined that it does not have sufficient information to estimate dose for the members of the proposed class from February 1, 1958 through May 31, 1958, and June 1, 1959 through June 30, 1959.

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

For the periods January 1, 1950 through January 31, 1958; June 1, 1958 through May 31, 1959; and July 1, 1959 through April 30, 2000, a health endangerment determination is not required because NIOSH has determined that it has sufficient information to estimate dose for the members of the evaluated class. Based on the sum of information from available resources, NIOSH's evaluation determined that April 30, 2000, was the last date for applicable EEOICPA program exposures at Westinghouse Electric Corp. (New Jersey).

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SEC Petition Evaluation Report for SEC-00217

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: Pat McCloskey, Oak Ridge Associated Universities (ORAU). The rationales for all conclusions in this document are explained in the associated text.

1.0 Purpose and Scope

This report evaluates the feasibility of reconstructing doses for all employees who worked in any plant production area of the Westinghouse Electric Corp. (New Jersey) site in Bloomfield, New Jersey, during the period from January 1, 1950 through March 1, 2011. It provides information and analyses germane to considering a petition for adding a class of employees to the congressionally-created SEC.

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

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

2.0 Introduction

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

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

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

[1] DCAS was formerly known as the Office of Compensation Analysis and Support (OCAS).
[2] NIOSH dose reconstructions under EEOICPA are performed using the methods promulgated under 42 C.F.R. pt. 82 and the detailed implementation guidelines available at http://www.cdc.gov/niosh/ocas.

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

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

3.0 SEC-00217 Westinghouse Electric Corp. (New Jersey) Class Definitions

The following subsections address the evolution of the class definition for SEC-00217, Westinghouse Electric Corp. (New Jersey), also referred to as Westinghouse, Westinghouse Electric Corp., and abbreviated as WEC throughout this report. When a petition is submitted, the requested class definition is reviewed as submitted. Based on its review of the available site information and data, NIOSH will make a determination whether to qualify for full evaluation all, some, or no part of the petitioner-requested class. If some portion of the petitioner-requested class is qualified, NIOSH will specify that class along with a justification for any modification of the petitioner's class. After a full evaluation of the qualified class, NIOSH will determine whether to propose a class for addition to the SEC and will specify that proposed class definition.

There is currently a class of Westinghouse Electric Corp. (New Jersey) workers already designated for inclusion in the SEC for the period from August 13, 1942 through December 31, 1949. The class, designated in May 2010, is associated with the NIOSH evaluation of petition SEC-00159 (NIOSH, 2010) under 42 C.F.R. § 83.14. In its 2010 evaluation, NIOSH determined that it lacks sufficient information, which includes biological monitoring data, air monitoring information, and process and radiological source information, to estimate with sufficient accuracy the potential internal and external exposures to uranium, thorium, and their respective progeny to which the class may have been subjected during AWE operations. During the 1942-1949 AWE period associated with SEC-00159, WEC produced uranium and thorium metal, with the main uranium processes including potassium

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

uranium pentafluoride production, uranium metal production, uranium metal powder production, pressing and sintering uranium metal powder, and the production of uranium metal buttons.

3.1 Petitioner-Requested Class Definition and Basis

Petition SEC-00217 was received on June 12, 2014, and qualified on January 8, 2015. The petitioner requested that NIOSH consider the following class: *All Atomic Weapons Employer employees who worked at any plant production area of Westinghouse Electric Corporation in Bloomfield, New Jersey from January 1, 1950 through March 1, 2011.*

The petitioner provided information and affidavit statements in support of the petitioner's belief that accurate dose reconstruction over time is impossible for the Westinghouse workers in question. NIOSH deemed the following information and affidavit statements sufficient to qualify SEC-00217 for evaluation:

> From 1950 to 1976, no radiation monitoring of Lamp Division employees was conducted and no dosimeter limit badges were issued before 1976.
>
> This petitioner is not aware of dosimeter badges issued after 1976 testing. [Redacted per Privacy Act] never wore a radiation limit dosimeter-badge during employment from 1950 to 1958, before retiring in 1959.
>
> No radiation readings were taken at Westinghouse until 1976 when the first radiation levels were taken at the Westinghouse plant buildings. There were no records found to show radiation levels at various buildings in 1949, 1950, 1953, or 1959 through 1976 when the first tests were ordered by the U.S. Nuclear Regulatory Commission (NRC).
>
> After several buildings were razed in 1978 and 1980-1981, addition radiation was found below former razed building sites in trenches where buried water and drain pipes were still radiating in 1993.

Based on its Westinghouse Electric Corp. (New Jersey) research and data capture efforts, NIOSH determined that it has access to area contamination and radiation data for Westinghouse Electric Corp. workers during the time period under evaluation. However, NIOSH also determined that personal monitoring records are not complete for all time periods or for all radionuclides. NIOSH concluded that there is sufficient documentation to support, for at least part of the requested time period, the petition basis that internal and external radiation exposures and radiation doses were not adequately monitored at Westinghouse Electric Corp., either through personal monitoring or area monitoring. The information and statements provided by the petitioner qualified the petition for further consideration by NIOSH, the Board, and HHS. The details of the petition basis are addressed in Section 7.4.

3.2 Class Evaluated by NIOSH

Based on its preliminary research, NIOSH accepted the petitioner-requested class. Therefore, NIOSH defined the following class for further evaluation: All employees who worked in any plant production area of the Westinghouse Electric Corp. (New Jersey) site in Bloomfield, New Jersey, during the period from January 1, 1950 through March 1, 2011.

At the time of qualification, the period to be evaluated by NIOSH was solely defined as the WEC residual radiation period, with the site's AWE operations period already being included in the SEC through December 31, 1949, as stated previously. Information obtained by NIOSH as part of this evaluation, indicated that WEC conducted two additional AWE-related uranium machining campaigns for Fernald during the periods May 12, 1958 through May 16, 1958, and June 25, 1959 through June 29, 1959. On September 26, 2014, NIOSH provided the information to DOL, and DOL consequently issued a change to the facility covered period designations (DOL, 2014):

- AWE Period……..…1942-1949; February-May 1958; and June 1959
- Residual Radiation Period……1950-March 1, 2011

NIOSH's evaluation that follows considers these two additional AWE operations periods within the site's residual radiation period.

Additionally, separate information obtained by NIOSH as part of this evaluation allows for updates to the site residual contamination status (see Section 5.1.2 below). Based on the sum of site remediation information from available resources, including interviews of site experts, NIOSH has determined that there was no potential for internal or external radiation doses from AWE-related residual contamination during the period of May 1, 2000 through March 1, 2011. Consequently, although the period from May 1, 2000 through March 1, 2011 is evaluated in this report, dose reconstruction is not required for this period.

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

Based on its research of the class under evaluation, NIOSH has defined a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. The NIOSH-proposed class to be added to the SEC includes all Atomic Weapons Employees who worked at the facility owned by Westinghouse Electric Corp. (New Jersey) in Bloomfield, New Jersey, during the period from February 1, 1958 through May 31, 1958, or during the period from June 1, 1959 through June 30. 1959, 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 included in the Special Exposure Cohort.

4.0 Data Sources Reviewed by NIOSH to Evaluate the Class

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

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

4.1 Site Profile Technical Basis Documents (TBDs)

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

- *Site Profiles for Atomic Weapons Employers that Worked Uranium Metals*, Rev. 01; effective June 17, 2011; SRDB Ref ID: 101251

4.2 ORAU Technical Information Bulletins (OTIBs) and Procedures

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

- *Dose Reconstruction During Residual Radioactivity Periods at Atomic Weapons Employer Facilities*, ORAUT-OTIB-0070, Rev. 01; effective March 5, 2012; SRDB Ref ID: 108851

- *Dose Reconstruction from Occupational Medical X-Ray Procedures*, ORAUT-OTIB-0006, Rev. 04; effective June 20, 2011; SRDB Ref ID: 98147

- *Guidance on Assigning Occupational X-ray Dose Under EEOICPA for X-rays Administered Off Site*, ORAUT-OTIB-0079, Rev.00; effective January 3, 2011; SRDB Ref ID: 89563

- *Estimation of Ingestion Intakes*, OCAS-TIB-009, Rev. 0; effective April 13, 2004; SRDB Ref ID: 22397

4.3 Facility Employees and Experts

To obtain additional information, NIOSH interviewed eight former Westinghouse employees. NIOSH's specific objectives were to gain further understanding of specific WEC operations with radioactive materials and to identify any radiological monitoring performed during those operations. Interviews were conducted via telephone and have been considered and referenced throughout this evaluation.

- Personal Communication, 2015a, *Personal Communication with Former Westinghouse Electric Corporation Employee*; Telephone Interview by ORAU Team; January 14, 2015; SRDB Ref ID: 141512

- Personal Communication, 2015b, *Personal Communication with Former Westinghouse Electric Corporation Employee*; Telephone Interview by ORAU Team; January 12, 2015; SRDB Ref ID: 141509

- Personal Communication, 2015c, *Personal Communication with Former Westinghouse Electric Corporation Subcontractor Employee*; Telephone Interview by ORAU Team and NIOSH; January 9, 2015; SRDB Ref ID: 141510

- Personal Communication, 2015d, *Personal Communication with Former Westinghouse Electric Corporation Subcontractor Employee*; Telephone Interview by ORAU Team; January 12, 2015; SRDB Ref ID: 141560

- Personal Communication, 2015e, *Personal Communication with Former Westinghouse Electric Corporation Subcontractor Employee*; Telephone Interview by ORAU Team; January 14, 2015; SRDB Ref ID: 141561

- Personal Communication, 2015f, *Personal Communication with Former Westinghouse Electric Corporation Employee*; Telephone Interview by ORAU Team; January 13, 2015; SRDB Ref ID: 141562

- Personal Communication, 2015g, *Personal Communication with Former Westinghouse Electric Corporation Employee*; Telephone Interview by ORAU Team; January 12, 2015; SRDB Ref ID: 141563

- Personal Communication, 2015h, *Personal Communication with Former Westinghouse Electric Corporation Subcontractor Employee*; Telephone Interview by ORAU Team; March 9, 2015; SRDB Ref ID: 141794

4.4 Previous Dose Reconstructions

NIOSH reviewed its NIOSH DCAS Claims Tracking System (referred to as NOCTS) to locate EEOICPA-related dose reconstructions that might provide information relevant to the petition evaluation. NIOSH reviewed each claim to determine whether internal and/or external personal monitoring records could be obtained for the employee. Table 4-1 summarizes the results of this review. (NOCTS data available as of March 4, 2015)

Table 4-1: No. of WEC. Claims Submitted Under the Dose Reconstruction Rule

Description	Totals
Total number of claims submitted for dose reconstruction	41
Total number of claims submitted for energy employees who worked during the period under evaluation (January 1, 1950 through March 1, 2011)	41
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).	37
Number of claims for which internal dosimetry records were obtained for the identified years in the evaluated class definition	0
Number of claims for which external dosimetry records were obtained for the identified years in the evaluated class definition	0

4.5 NIOSH Site Research Database

NIOSH also examined its Site Research Database (SRDB) to locate documents supporting the assessment of the evaluated class. There were 496 documents in this database identified as pertaining to Westinghouse Electric Corp. (New Jersey). These documents were evaluated for their relevance to this petition. The documents include historical background on monitoring and program descriptions (e.g., air monitoring, urinalysis data, radiation and surface contamination surveys, radiological control program information, medical monitoring, process materials, and process descriptions).

4.6 Documentation and/or Affidavits Provided by Petitioners

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

- *Affidavit Regarding Personal Radiation Monitoring to Support Statement to NIOSH*; November 24, 2014; DSA Ref ID: 120481

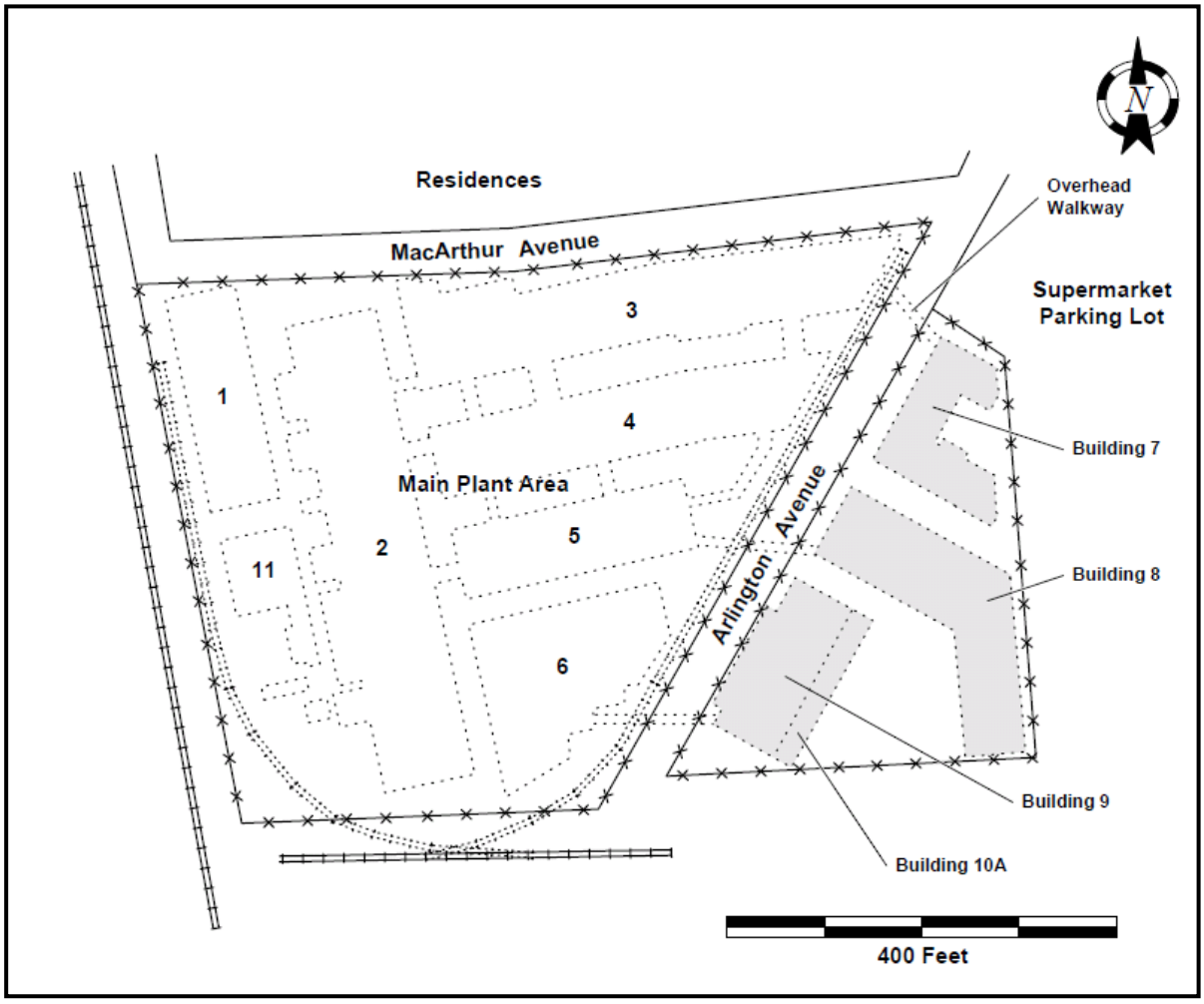
- *Form B for Westinghouse Electric Corporation*; received June 12, 2014; DSA Ref ID: 120005

5.0 Radiological Operations Relevant to the Class Evaluated by NIOSH

The following subsections summarize both radiological operations at Westinghouse Electrical Corp. from January 1, 1950 through March 1, 2011, and the information available to NIOSH to characterize particular processes and radioactive source materials. From available sources NIOSH has gathered process and source descriptions, information regarding the identity and quantities of each radionuclide of concern, and information describing processes and the physical environment in which radiation exposures may have occurred. The information included within this evaluation report is intended only to be a summary of the available information.

5.1 Westinghouse Electric Corp. (New Jersey) Plant and Process Descriptions

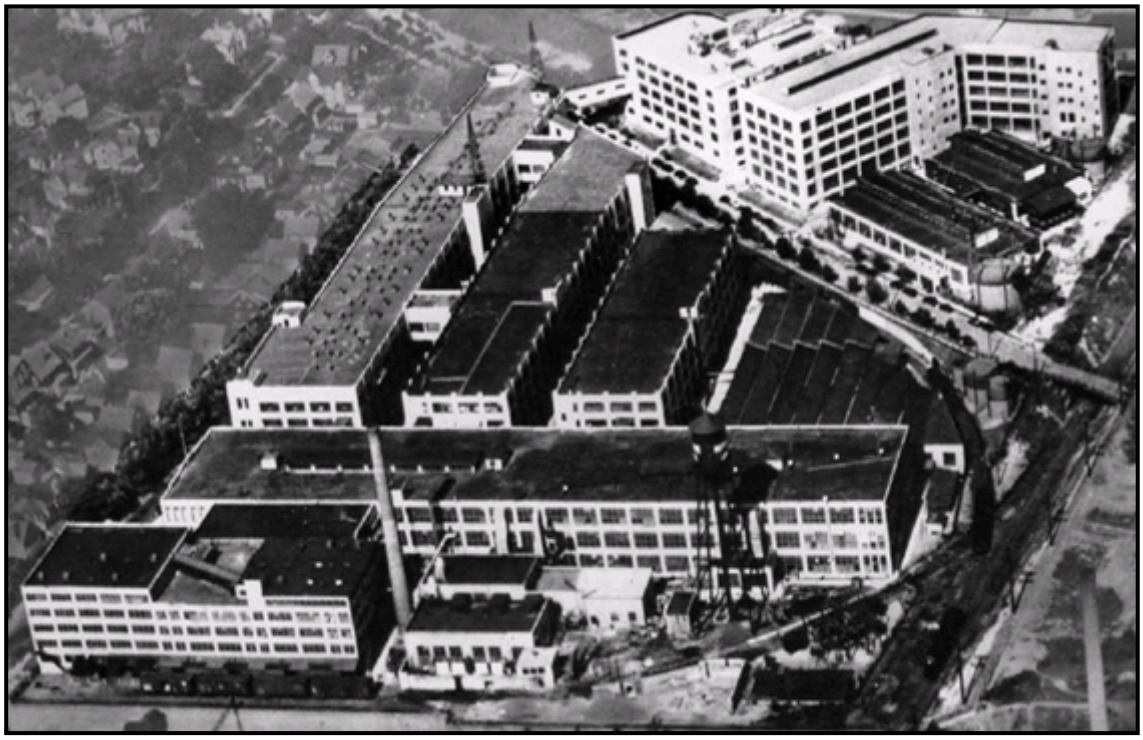
Westinghouse Electric Corp. was located in Bloomfield, New Jersey, on a 14-acre site. It was comprised of eleven principal buildings (identified as Buildings 1 through 11) and several lesser structures, including a garage. However, AWE work was only performed in the basement and on the roof of Building 7 (Roberts, 1993, PDF p. 6). The site is bounded by MacArthur Avenue to the north, railroad tracks to the west and south, and by commercial properties along Bloomfield Avenue to the east. The site is divided into two parcels by Arlington Avenue which runs generally southwest to northeast. The garage lies on the opposite side of MacArthur Avenue across from Building 1 (Maroncelli, 2007).



Source: Maroncelli, 2007, PDF p. 562

Figure 5.1: Plot plan of Westinghouse Electric Corp., Bloomfield, New Jersey

Most of the principal buildings have multiple floor levels. The buildings, constructed between 1907 and 1930, contain approximately 93,000 m^2 (1,000,000 ft^2) of floor space and cover approximately half of the area of the site (Photo, undated).



Source: Photo, undated

Figure 5.2: Aerial photograph of Westinghouse Electric Corp. (New Jersey)

The buildings are constructed primarily of concrete and steel foundations and frames, concrete floors, and brick and concrete block walls. Wood flooring is present in several manufacturing and warehouse areas throughout the facility. Office areas consist of wood frame walls with tile or carpeted floors. Buildings 1 through 6 and Building 11 contain approximately 65,000 m^2 of floor space, of which approximately 49,000 m^2 is manufacturing or warehouse space. The remaining 16,000 m^2 consists of offices, conference rooms, a hospital, a company store, a cafeteria, and restrooms (Adams, 1992, PDF p. 12).

Most of the areas between the buildings are paved with asphalt or concrete. The primary unpaved areas on the site include a small reservoir for fire-protection water behind Building 2, a large incinerator that is also behind Building 2, and the areas adjacent to the railroad tracks.

For the period evaluated by NIOSH, the Westinghouse Electric Corp. (New Jersey) workforce consisted of approximately 8,000 workers, circa 1957 (Gibson, 2004, PDF p. 2). Commercial operations associated with radioactive materials at WEC do not appear to have been large-scale, although they appear to have involved various areas of the site. NIOSH has reviewed a document stating that for a period of time in the early 1960s, 26 employees performed the commercial radiological work during part of three shifts at less than 100 man-hours per year total (SMB-353, 1961-1962). Another document shows that 78 employees were monitored for external penetrating radiation and assigned film badges during the year 1960. All results were in the zero to 1 REM range for the year, as reported to the New York Operations Office of HASL (Monitoring, 1960, PDF p. 39).

NIOSH reviewed another document stating that thorium operations, beginning in the late 1960s and lasting for at least 15 years, were performed by one individual (SMB-1423, 1984-1985).

5.1.1 Site Operations History

During World War II, WEC was contracted to produce uranium in support of the MED. Operations during this period, from August 1, 1942 through December 31, 1949, are also described in *SEC Petition Evaluation Report for Petition SEC-00159* (NIOSH, 2010).

WEC developed a photochemical technique to produce uranium metal using uranium oxide or nitrate and potassium fluoride. The process was used to produce limited quantities of uranium. (Under the best weather conditions with good sunlight, the process could produce 1 ton/month.) The green salt produced by the reaction was electrolyzed to yield uranium metal that was subsequently cast into discs, pellets, and ingots (DOE, undated). The contract began on August 1, 1942 (DOE, undated) and was completed on October 15, 1943 (Unspecified, 1942-1943), and would have been capable of producing a total of 14.5 tons of uranium metal. At the end of this contract in 1945, the process equipment was removed (DOE, undated) and the uranium production facility was deactivated. After deactivation, the basement area was used primarily as a research testing laboratory (Westinghouse, 1980, PDF p. 30).

WEC also worked with thorium under contract W-7409-ENG-31 for the MED. They produced a total of 200 pounds of thorium metal in the form of bars, tubes, sheets, and wire in early 1945 (Uranium, undated, PDF p. 4).

WEC also performed natural uranium machining operations for Fernald during short-term projects under contract from February 1958 through May 1958 and throughout June 1959. During these projects, WEC performed test rollings of uranium tubes on the Assel Mill to evaluate whether this process could be used to elongate hollow fuel rods for eventual use in a nuclear reactor as part of the nuclear weapons production complex (Simmons, 1959, PDF p. 74). The actual machining was scheduled to take one or two days (Kirkman, 1958, PDF p. 6), and the first test was attended by a Health and Safety Laboratory (HASL) representative, May 12 through May 16, 1958 (Ross, 1958). The work was performed on a No.1 Witter mill (also known as an Assel mill) (Simmons, 1958, PDF p. 100). The first test was unsuccessful because of excessive slippage between the work piece and the roll surfaces. A second rotary-elongation test was conducted on the same mill in June 1959. The actual machining during this second test occurred from June 25 through June 29, 1959, as indicated by the air monitoring dates (Monitoring, 1959). The mill-roll speed was reduced to 43 rpm (128 rpm was used in the previous test) (Steck, 1963).

NIOSH is not aware of any additional uranium machining operations at WEC after June 30, 1959 (Ansari, 1993, PDF p. 12).

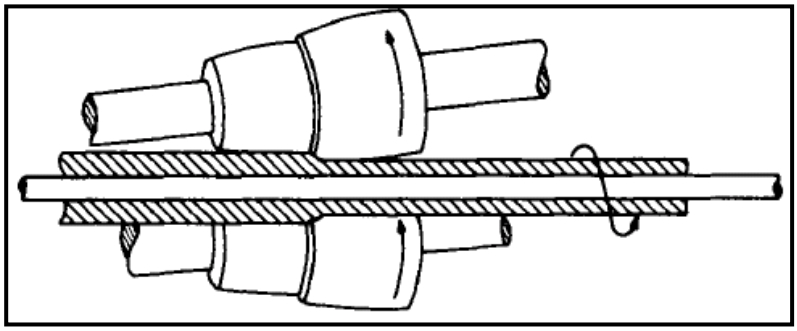


Figure 5.3: Assel Mill Rolls during tube elongation

Records indicate that on July 12, 1961, AEC issued a commercial license to WEC, License No. SMB-353, to conduct R&D with thorium and uranium and to manufacture thorium-tungsten wire (for lighting applications) and thorium-containing welding rods. The license required WEC personnel to clean and maintain the work areas free of contamination, and to survey themselves upon exiting the work areas (SMB-353, 1961-1962, PDF p. 6). A second license, AEC License No. STB-467, was also issued to WEC for using thorium in the manufacture of mercury vapor lamps. The two licensed activities were consolidated under License No. SMB-353, and License No. STB-467 was subsequently terminated in November 1967 (Roberts, 1993, PDF p. 5).

In 1976 the Energy Research and Development Administration (ERDA) began a review of the radiological status of the facilities involved in supporting the MED under the Formerly Utilized Sites Remedial Action Program (FUSRAP) (Roberts, 1993, PDF p. 5). An October 1976 survey by ERDA staff identified contamination in the basement of Building 7 in floor drains, along the base of the walls and support columns where the walls joined the floor, and around support columns of a loading dock at the rear of the building. This survey was limited to Building 7 since it was the only portion of the WEC facility where MED work was performed (Roberts, 1993, PDF p. 6). After the ERDA survey results, WEC used the services of an outside contractor to clean contaminated areas at their own expense. Although some contamination remained above the then-current criteria for release for unrestricted use, ERDA did not recommend further remediation, but suggested that the residual contamination be licensed by the NRC as a means of further radiological control. In February 1978, WEC requested that the NRC amend their license to include this residual contamination (Roberts, 1993, PDF p. 6).

On September 29, 1977, Building 10 was released and approved for demolition by the NRC (SMB-353, 1977-1980, PDF p. 6).

In May 1979, the NRC informed WEC that the NRC would not amend the license and that they believed that the Building 7 basement should be decontaminated. In November 1979, a WEC contractor performed remediation in the contaminated areas. Additional remediation was conducted in April 1980 following the discovery of several contaminated areas during a February 1980 NRC survey. Following a January 1981 survey, the NRC indicated in a letter to WEC that the Building 7 basement had been satisfactorily decontaminated (Roberts, 1993, PDF p. 6).

In February 1983, WEC sold the lamp manufacturing business to North American Philips Company (NAP). As part of this sale, NAP operated the Bloomfield Lamp Plant facilities, but only leased the plant from WEC. The NRC issued License No. SMB-1423 to NAP and terminated License No. SMB-353 issued to WEC. The license issued to NAP only authorized manufacturing of products containing thorium. In 1984, NAP stopped thorium wire production and ceased all manufacturing operations at the site in 1985. By November 1986, NAP moved from the Bloomfield facility. In May 1988, the NRC amended the NAP license to authorize only storage of the licensed radioactive material that was currently at the facility. Since NAP had only leased the Bloomfield facility, WEC then took control of the facility (Roberts, 1993, PDF p. 6).

In November 1988, WEC submitted an application for a license to authorize D&D of the site. Included in the license request was a D&D plan and the results of radiological surveys conducted in 1986 and 1988 that characterized the quantity and extent of radioactive contamination at the Bloomfield site. WEC also requested that the NAP license be terminated and that a new license be issued to WEC. In February 1989, NRC issued License No. SMB-1527 to WEC for D&D of the Bloomfield site and terminated NAP's License No. SMB-1423 (Roberts, 1993, PDF p. 6).

The contaminated areas of the site were remediated from 1989 through 1990 by Scientific Ecology Group (SEG), a contractor for WEC. The major interior remediation work was performed in Buildings 2 through 6 and the garage. Significant exterior remediation work was conducted in the reservoir area, the incinerator, and along the railway spurs behind Buildings 4 and 6. Remediation activities were not performed on any of the roofs of the buildings since contamination in excess of the criteria was not identified on these areas. The total remediated area (interior and exterior) covered approximately 1,600 square meters (17,200 square feet). In May 1990, WEC submitted a report with the results of a confirmatory survey for Buildings 1 through 6, the garage, and property on the west side of Arlington Avenue, and requested these buildings and property be released for unrestricted use. This report also briefly discussed the extent of the remediation of each contaminated area. Specifying that remediation was continuing on Buildings 7, 8, and 9 and the area east of Arlington Avenue. WEC stated they would make a separate request to release these buildings once remediation was completed (Roberts, 1993, PDF p. 9).

For areas inside buildings, contaminated concrete was removed by scabbling, chipping, or grinding with air-operated tools since contamination on these areas was generally limited to the surface of the floor or wall. Vacuuming was used to remove loose contamination and the residue generated during concrete remediation. Contaminated tile or wood floors were completely removed and disposed as radioactive waste. Contaminated pipe was also completely removed and disposed. Contaminated soil around these pipes was excavated until soil samples showed concentrations less than the criteria for release for unrestricted use. Drums filled with radioactive residues and piles of radioactive debris were packaged and disposed as radioactive waste. Contaminated equipment and fixtures that could not be readily cleaned (e.g., ducts, blowers and filters) were cut into pieces and disposed in a similar manner. Sumps or contaminated metal equipment were steam cleaned to remove contamination and to limit the overall volume needing disposal (Roberts, 1993, PDF p. 10).

Contamination in outside areas was handled in a manner similar to that inside buildings. Concrete pads were chipped or scabbled to remove contamination and the resultant debris was discarded as radioactive waste. In the reservoir and rail spur areas, contaminated soil was excavated from areas as large as 5.3 meters (17.5 feet) by 24.4 meters (80 feet). Soil contamination in excess of the acceptable

criteria typically did not exceed a depth of 0.6 meters (2 feet). Railroad tracks and railroad ties were removed from the rail beds and pressure washed to remove contamination. The contaminated ash residue from the incinerator building and stack was collected and disposed as radioactive waste. All radioactive waste was sent to the SEG facility in Oak Ridge, Tennessee, for incineration, compaction, or repackaging. Wastes were eventually disposed at a licensed, low-level radioactive waste disposal facility. The waste was typically shipped in B-25 containers (strong, tight containers of approximately 2.5 cubic meters [90 cubic feet]) (Roberts, 1993, PDF p. 10).

In May 1990, RMC/Canberra, a health physics support contractor for WEC, submitted final release surveys for Buildings 1-6 to the NRC (Monitoring, 1989-1990, PDF pp. 20, 36). From March 11-16, 1991, Oak Ridge Institute for Science and Education (ORISE) performed an over-check of the RMC/Canberra surveys for the NRC and found several areas of Buildings 1-6 still contaminated (Adams, 1992, PDF p. 19). As a result of the ORISE contamination findings, during April-September 1991, SEG performed additional remediation of the contaminated areas (found by ORISE) over a period of 14 days, resulting in 53 waste shipments containing 44,000 ft^3 (317 mCi) of waste (Bickerstaff, 1991, PDF pp. 2, 16). RMC/Canberra then performed additional surveys after SEG's decontamination effort and submitted them to the NRC (Bickerstaff, 1991, PDF pp. 2, 16). On June 5, 1992, an NRC Inspector surveyed the contaminated areas found by ORISE and remediated by SEG and determined that Buildings 1-6 remediation is complete. The NRC amended license SMB-1527 and released Buildings 1-6 for unrestricted use on May 25, 1993 (Roberts, 1993, PDF p. 2).

On May 10-14, 1993, after WEC declared remediation complete, ORISE performed an independent confirmatory survey of Buildings 7, 8, 9, 10A, and associated properties located on the east side of Arlington Avenue for the NRC. ORISE identified several areas with residual radioactive contamination in excess of then-current decommissioning criteria (Inspection, 1994, PDF p. 5).

By December 1995, SEG completed remediation of the rest of the WEC site (Buildings 7-10) except for:

- Soil and bedrock beneath a portion of the Building 7 basement floor
- Subsurface storm drain with fixed (internal) contamination, partially located beneath Arlington Avenue
- A storm drain with fixed (internal) contamination, located beneath first floor of Building 7 (SEG, 1996, PDF p. 8)

In summer 1999, Buildings 7 and 8 were razed (ESC, 2000, PDF p. 11).

In July 1999, the remediation of the three remaining areas was initiated and by April 30, 2000, the remediation of the three remaining areas was complete (ESC, 2002, PDF p. 5; Personal Communication, 2015h).

In January 2001, the final-status release surveys were sent to the NRC (ESC, 2001). In May 2001, the NRC and the State of New Jersey's Department of Environmental Resources were satisfied with the remediation results except that they requested additional information about the backfill material, and a dose assessment for potential groundwater exposures (Lipoti, 2001). On February 13, 2003, the requested dose assessment was sent to the NRC (Hendricks, 2003). The final NRC license for D&D

was terminated on August 13, 2003, and the entire site was released for unrestricted use by the NRC (Costello, 2003).

5.1.2 Period of AWE-Related Residual Contamination

NIOSH is aware of decontamination activities that took place at the completion of AWE operations in 1945 (Westinghouse, 1980, PDF p. 30) and in 1958 (Ross, 1958). NIOSH also reviewed formal D&D activities that started at WEC in 1976, and continued onsite (including Building 7) until 2000, as described previously in Section 5.1.1 of this report. Information obtained by NIOSH as part of this evaluation, allow for updates to the site residual contamination status as presented in the most recent revision of NIOSH's *Report on Residual Radioactive and Beryllium Contamination at Atomic Weapons Employer Facilities and Beryllium Vendor Facilities* (NIOSH, 2011). As stated previously, the final NRC license for D&D was terminated on August 13, 2003, and the entire site was released for unrestricted use by the NRC (Costello, 2003). This site release decision was based upon the final remediation operations completed on April 30, 2000 (ESC, 2002, PDF p. 5; Personal Communication, 2015h). Consequently, based on the sum of information from available resources including ERDA/DOE FUSRAP documents, AEC/NRC license termination activities, and interviews of site experts, NIOSH has determined that there was no potential for internal or external radiation doses from AWE-related residual contamination during the period from May 1, 2000 through March 1, 2011.

5.1.3 Commercial Operations Performed Concurrently with AWE Operations

Radiation doses from commercial operations are required to be assessed during the site AWE operations periods for the entire site. Consequently, NIOSH reviewed available information regarding the site commercial operations leading up to, and during, the AWE periods in 1958 and 1959. NIOSH interviewed former WEC employees and representatives and asked specifically about monitoring records for commercial operations and has located only limited source term information. Commercial operations with radioactive material were performed in all eleven WEC buildings at one time or another throughout the site's history. NIOSH searched for monitoring and source term data from commercial operations for the periods from February 1, 1958 through May 31, 1958 and June 1, 1959 through June 30, 1959; the only information found during this time frame is provided below.

The first commercial license that NIOSH has located for WEC was Atomic Energy Commission (AEC) license R-126, beginning on May 1, 1954. This license authorized WEC to use compounds with thoria content at a rate of 50 lbs. per month. These thorium compounds were used for research and development (R&D) in their lamp development work, as a strengthener for their tungsten filaments, and for the manufacture of lamps. This license also authorized WEC to use uranium in R&D for their lamps and in the manufacture of switches. In 1956, WEC requested a modification to this license to increase the amount of thorium compounds they could possess to a rate of 150 lbs. per month (thoria content 65 lbs. per month) (R-126, 1955-1956, PDF pp. 3-6). The 1959 renewal of this license increased the amount again and authorized WEC to possess 2000 lbs of source material (License Renewal, 1959, PDF pp. 10).

NIOSH has found the following source-term data (inventory):

- 175 lbs of thorium and 120 kg of uranium in 1956 (R-126, 1955-1956, PDF pp. 11)
- 185 lbs of thorium and 103 kg of uranium in 1957 (Kirkman, 1958, PDF p. 8)
- 191 lbs of thorium and 132 kg of uranium in 1958 (License Application, 1958, PDF pp. 12, 13)
- 100 lbs of thorium and 137 kg of uranium in 1959 (License Application, 1959, PDF pp. 8, 9)
- 293 lbs of thorium and 104 kg of uranium in 1960 (License Application, 1960, PDF pp. 7, 8).

An inspection by the New York Operations Office (Kirkman, 1958, PDF p. 6) on January 27, 1958, documented that:

- Operations on the third floor of Building 8 were consuming thorium compounds at a rate of several pounds per month, and on the second floor, gram quantities of uranium were occasionally used to make filaments.
- In Building 9 on the first floor, approximately 400 kg of thorium was present, of which 300 kg was in storage and the rest used in the production of thoriated tungsten.
- In Building 7, uranium and thorium were stored in the basement and on the first floor.

A letter written by NAP in 1986 to the New Jersey Department of Environmental Protection provides the following building descriptions (Decontamination Efforts, 1986):

- Building 2 - Thorium emission work 1950s to 1971. 2nd floor rear.
- Building 6 - Thorium furnace area.
- Building 7 - Thorium nitrate. Room 106 through 1985.
- Building 8 - Thorium emission work prior to 1967. 3rd floor back-end of building. Equipment relocated to Building 10.
- Building 9 - Thorium manufacturing - ingot sintering.
- Building l0A - Thorium manufacturing lab licensed for manufacture and storage.

NIOSH had been unable to locate personnel monitoring data specific to the commercial thorium and uranium commercial operations indicated above.

5.2 Radiological Exposure Sources from Westinghouse Electric Corp. Operations

The following subsections provide an overview of the internal and external exposure sources for the Westinghouse Electric Corp. (New Jersey) class under evaluation.

NOTE: The additional AWE Operational Periods defined by DOL (see Section 3.2 above) are considerably longer than the periods of active machining during the second and third processing campaigns. During these AWE operations periods, all commercial exposures that occurred at the covered facility (i.e., Buildings 1-11) during these longer periods contribute to the Energy Employee's covered exposure requiring dose reconstruction. AWE-contracted work only occurred in Building 7;

however, non-AWE radioactive materials were utilized in all eleven buildings as part of WEC's commercial operations during the AWE operational periods (Costello, 2003, PDF p. 3). NIOSH interviewed former WEC employees and representatives and asked specifically about monitoring records for commercial operations, and has not located any such records to date. NIOSH does not have information sufficient to evaluate these additional commercial exposures during the two AWE operations periods being evaluated.

5.2.1 Internal Radiological Exposure Sources from Westinghouse Operations

The primary potential sources of internally deposited radioactivity resulting from WEC operations were inhalation and ingestion of uranium and thorium. This section addresses exposures to alpha emitting radionuclides at WEC.

5.2.1.1 Uranium

There were three separate AWE operations periods at WEC. The first of these periods began on August 1, 1942, and ended on December 31, 1949, which is prior to the period being evaluated in this report and was previously evaluated in *SEC Petition Evaluation Report for Petition SEC-00159* (NIOSH, 2010). However, the residual activity from this first operational period will be considered in this report.

As described in *SEC Petition Evaluation Report for Petition SEC-00159* (NIOSH, 2010), WEC's first AWE contract began on August 1, 1942 (DOE, undated) in Building 7 and was completed on October 15, 1943 (Unspecified, 1942-1943). For this first AWE contract, WEC used photochemical and electrolysis techniques to purify uranium oxides and nitrates to make uranium metal that was subsequently cast into discs, pellets, and ingots (DOE, undated). This process was capable of producing a total of 14.5 tons of processed uranium metal (i.e., natural isotopic abundances of U-234, U-235, and U-238, without the decay products from U-234, notably Ra-226 and Rn-222 progeny) (Costello, 2003, PDF p. 2).

WEC's second and third AWE contracts were small-scale test rollings (i.e., elongation) of natural uranium metal, hollow fuel rods. The second AWE contract started on February 1, 1958, and ended on May 31, 1958. However, NIOSH has found indications that potential uranium machining exposures occurred only during operations from May 12, 1958 through May 16, 1958. During this second contract, eighteen 4-inch by 24-inch uranium tubes were shipped to WEC; however, only six tubes were tested. These tubes were first heated to 800-1200º F in an argon furnace prior to being rolled on the Assel mill. When a test was complete, the mill was decontaminated by filing the embedded uranium off of the rollers and vacuuming the debris (Ross, 1958, PDF pp. 3-4).

The third AWE contract started on June 1, 1958 and ended on June 30, 1959; however, NIOSH found indications that potential uranium machining exposures occurred only during operations from June 25, 1959 through June 29, 1959. The significant changes made for the third campaign consisted of the Assel mill being used at considerably slower speeds (43 rpm was used instead of 128 rpm used in the first test) and the tube preheat temperature being changed to 950-1200º F (Simmons, 1959, PDF p. 73).

As indicated in Section 5.1.3, NIOSH has indications of licensed commercial uranium operations starting in 1954, with uranium inventories available for the years 1956 through 1960. NIOSH has found no operations or process descriptions, or descriptions of radiological exposure conditions, related to WEC's commercial handling of uranium during these years for the production of lamp filaments or R&D efforts. Such information regarding the commercial handling of uranium is required by NIOSH for the AWE periods from February 1, 1958 through May 31, 1958, and June 1, 1959 through June 30, 1959.

5.2.1.2 Thorium

As described in *SEC Petition Evaluation Report for Petition SEC-00159* (NIOSH, 2010) and Section 5.1 of this report, the one and only AWE contract for work with thorium ended prior to the period being evaluated in this report, and was previously evaluated in the SEC-00159 Evaluation Report. However, the radiological exposures from residual thorium activity from this earlier period will be considered for the period under evaluation in this report.

WEC worked with thorium for the MED under contract W-7409-ENG-31, providing thorium for the X-10 reactor at Oak Ridge, Tennessee (Contracts, 1945-1946, PDF p. 9). They produced a total of 200 pounds of thorium metal in the form of bars, tubes, sheets, and wire in early 1945 (Uranium, undated, PDF p. 4). NIOSH has limited information on Westinghouse Electric Corp. AWE operations with thorium.

As indicated in Section 5.1.3, NIOSH has indications of licensed commercial thorium operations starting in 1954, with commercial thorium inventories available for the years 1956 through 1960. Indications are that the use of thoria-containing materials for the commercial production of tungsten filaments and lamps was increasing from 1956 through 1959. NIOSH has found no operations or process descriptions, or descriptions of radiological exposure conditions, related to WEC's commercial handling of thorium during these years for the production of lamp filaments or R&D efforts. Such information regarding the commercial handling of thorium is required by NIOSH for the AWE periods from February 1, 1958 through May 31, 1958, and June 1, 1959 through June 30, 1959.

5.2.2 External Radiological Exposure Sources from Westinghouse Operations

Based on information available to NIOSH, WEC had the potential for external radiation (photon/beta) exposure from uranium source material, its decay products, and small amounts of uranium and thorium surface contamination present after operations ceased.

The following subsections provide an overview of the external exposure sources at WEC.

5.2.2.1 Photon

Uranium emits both beta particles (electrons) and photons (gamma and X-rays). The two primordial components of natural uranium are U-238 and U-235, but some of their decay products grow into equilibrium fast enough to contribute to worker exposures during metal processing. External exposures to photon radiation would have resulted from the immediate daughter radionuclides in the uranium decay chain. The uranium progeny that result in the most significant photon exposures include Th-234 and Pa 234m (Rad Handbook, 1970). Note that these isotopes have relatively short

half-lives and can be assumed to be in equilibrium with the parent U-238. Because of their short half-lives, the exposure potential from these isotopes would follow the parent and will not be considered separately in this document.

Uranium-235 emits alpha particles and gamma photons in about 70% of its transitions, but occurs at 0.720% abundance in natural uranium.

The majority of the photons from natural uranium metals are in the 30-250 keV energy range (Battelle-TBD-6000). However, solid uranium objects provide considerable shielding of the lower energy photons and "harden" the spectrum, causing the majority of photons emitted from a solid uranium object (e.g., a slug or rod) to have energies greater than 250 keV. While it is recognized that solid uranium sources will have a hardened photon spectrum, exposure to a thin layer of uranium on a surface will result in a larger fraction of exposure to lower-energy photons (Battelle-TBD-6000).

The beta and photon emissions of the radionuclides of major external exposure concern can be found in most standard health physics reference documents. Exposure to these emissions was possible for the period under evaluation during metal-handling activities and from submersion in contaminated air. Therefore, for the purposes of this evaluation, deep-dose estimates from the uranium sources at WEC are evenly distributed between photons with E=30-250 keV and photons with E= >250 keV.

Thorium has a significant number of higher-energy photons in the Th-232 decay chain. Based on the half-lives of the progeny, only a partial equilibrium is possible; therefore, it is conservative to state that equilibrium would be reached in this decay chain. It has been assumed that Ra-228 and Th-228 progeny were in equilibrium with Th-232. Under this assumption, the progeny are the major source of both penetrating and non-penetrating external exposure.

5.2.2.2 Beta

Beta particle radiation was the dominant source of external radiation exposure associated with uranium-machining activities at WEC, primarily from U-238 decay products. For example, nearly the entire beta radiation field from uranium comes from the daughter radionuclide Pa-234m, and to a lesser extent from Th-234. The surface beta dose-rate from a uranium slab is approximately 233 mrad per hour.

Beta doses to the skin, extremities, and (sometimes) the lens of the eye can be limiting in facilities that process uranium. Potentially significant skin exposure from uranium occurs primarily from the Pa-234m beta particles at tissue depths of 4 mg/cm^2 and greater. At 2.29-MeV (Emax), beta particles from Pa-234m are the most energetic contributors to the beta exposure.

There are a significant number of high-energy betas representing a shallow dose concern for WEC workers. Workers who handled uranium metal at WEC would have received these shallow doses. The primary exposure areas would have been the hands and forearms, the neck and face, and other areas of the body that were not covered.

5.2.2.3 Neutron

Neutron exposures were not evaluated for WEC because they are negligible for natural-uranium metal-handling facilities (Battelle-TBD-6000), and for the residual quantities of thorium present during the evaluated period (ORAUT-OTIB-0024).

5.2.3 Incidents

NIOSH is aware of small fires that occurred during uranium machining operations during the second AWE operational period in May 1958 (Ross, 1958). A site visit report by a HASL representative states:

> *When the tube enters the mill a large amount of sparking occurs. This causes small fires in the mill and an appreciable amount of smoke (assumed to be UO_2) is released into the atmosphere.*
>
> *During the rolling operation several small fires were observed in the mill and the area beneath it.*
>
> *The first tube in the mill was chewed up by the rolls. This was accompanied by a great deal of smoke and sparks from burning uranium.*

The HASL representative collected air samples after several fires and made recommendations to WEC to ensure mitigation of the problem and to prevent future occurrences. NIOSH has not reviewed reports of additional fires occurring as part of subsequent AWE operations.

To date, NIOSH has not discovered any events at WEC that would be inconsistent with machining operations typical of this time period and described in Battelle-TBD-6000.

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

The following subsections provide an overview of the state of the available internal and external monitoring data for the Westinghouse Electric Corp. class under evaluation. NIOSH has reviewed monitoring data from WEC's commercial and D&D operations; however, data that do not pertain to covered operations will only be summarized here.

NIOSH has determined that there was no potential for internal or external radiation doses from AWE-related residual contamination during the period from May 1, 2000 through March 1, 2011. Consequently, although the period from May 1, 2000 through March 1, 2011, is evaluated in this report, dose reconstruction is not required for this period.

6.1 Available Westinghouse Electric Corp. Internal Monitoring Data

NIOSH has reviewed a report of an AWE period HASL site visit conducted from May 12 through May 16, 1958. The purpose of the HASL visit was to observe the health and safety aspects of machining uranium and to supervise and ensure decontamination of WEC. During the visit, HASL performed gross alpha air monitoring prior to work, during work, and after decontamination. HASL collected 7 breathing zone (BZ) air samples that ranged from 3 to 6595 dpm/m^3 and 39 general area

(GA) air samples that ranged from 1 to 4395 dpm/m^3 (see Figure 7.1). The BZ samples were collected while transferring the uranium fuel tubes from the Argon furnace to the Assel mill, and during mill operations. The GA samples were collected before, during, and after Assel mill, stripper, and Argon furnace operations. GA samples were also collected after several small fires caused by rolling operations, and at the completion of all clean up and decontamination. HASL also documented that a representative from Health and Safety should be present to evaluate the process and supervise the decontamination during subsequent test rollings at WEC (Ross, 1958).

NIOSH has also reviewed data from gross alpha air monitoring performed during subsequent AWE period rollings on June 25, 1959 through June 29, 1959 (see Figures 7.2-7.5). During these operations, 7 BZ air samples were collected that ranged from 185 to 5551 dpm/m^3 and 20 GA air samples that ranged from no detectable to 3816 dpm/m^3. The BZ samples were collected during mill rolling and stripping operations. The GA samples were collected before, during, and after Assel mill, stripper and Argon furnace operations. GA samples were also collected during tube inspections and while vacuuming a half hour after rolling ceased (Monitoring, 1959).

NIOSH has been unable to locate internal monitoring data related to WEC commercial operations during the period from January 1, 1950 through April 30, 2000, including the two AWE operations periods. NIOSH interviewed former WEC employees and representatives and asked specifically about monitoring records for commercial operations, and has not located any such records to date. Radiation doses from commercial operations are required to be assessed during the site AWE operations periods.

6.2 Available Westinghouse Electric Corp. External Monitoring Data

NIOSH has not discovered any dosimetry data for covered AWE work. However, one AWE-period document shows that the May 12 through May 16, 1958 uranium machining work area was decontaminated after operations were complete, and a survey of the work area and mill showed that radiation levels were less than 0.1 mrep/hr beta gamma (Ross, 1958, PDF p. 4).

Seventy-eight employees were monitored for external penetrating radiation and assigned film badges during the year of 1960. All results were in the zero to 1 REM range for the year, as reported to the New York Operations Office of HASL (Monitoring, 1960, PDF p. 39).

WEC's commercial license required the use of film badge dosimeters beginning in 1961 (SMB-353, 1961-1962). Another report describing WEC's commercial operations states that film badges were placed in designated areas and worn by all personnel performing work and were read monthly by Landauer. Hand exposures were evaluated by timing the operations and measuring radiation levels at the hand location. The highest recorded exposure in this report was 45 mr/yr (SMB-353, 1964, PDF p. 13).

A 1970 report from an AEC inspection documents that Landauer reports were reviewed for 1969-1970, with most recorded doses being less than detectable and the highest quarter was 450 mr whole-body and 490 mr on a ring dosimeter (SMB-353, 1970, PDF p. 6).

NIOSH has been unable to locate additional external monitoring data related to WEC commercial operations during the period from January 1, 1950 through April 30, 2000, including the two AWE operations periods. NIOSH interviewed former WEC employees and representatives and asked specifically about monitoring records for commercial operations, and has not located any such records to date. Radiation doses from commercial operations are required to be assessed during the site AWE operations periods.

7.0 Feasibility of Dose Reconstruction for the Class Evaluated by NIOSH

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

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

- The sufficiency and reliability of the available data. (Section 7.1)
- The feasibility of reconstructing internal radiation doses. (Section 7.2)
- The feasibility of reconstructing external radiation doses. (Section 7.3)
- The bases for petition SEC-00217 as submitted by the petitioner. (Section 7.4)

7.1 Pedigree of Westinghouse Electric Corp. Data

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

7.1.1 Internal Monitoring Data Pedigree Review

NIOSH has not discovered any bioassay data. However air monitoring data are available from which to determine worker doses during uranium operations from May 12, 1958 through May 16. 1958 and June 25, 1959 through June 29, 1959. The data sources are copies of original reports and are therefore considered primary data sources. The data reported by AEC representatives would have been collected in accordance with standard practices using state-of-the-art methods of the day.

7.1.2 External Monitoring Data Pedigree Review

NIOSH has not discovered any dosimetry data for covered work. However, NIOSH has reviewed one document that reports radiation levels for the AWE operations area on May 16, 1958. The data source is a copy of an original report and is therefore considered to be a primary data source. The data reported by AEC representatives would have been collected in accordance with standard practices using state-of-the-art methods of the day.

7.2 Evaluation of Bounding Internal Radiation Doses at Westinghouse Electric Corp.

During AWE operations periods (February 1, 1958 through May 31, 1958, and June 1, 1959 through June 30, 1959), the principal source of AWE-related internal radiation doses for members of the class under evaluation was the potential inhalation and ingestion of airborne uranium by employees, both those nearby and those directly involved in AWE-related machining at WEC. During these 1958 and 1959 AWE operations periods, NIOSH must also evaluate WEC's concurrent commercial radiological work with uranium and thorium, as presented in Section 5.1.3. NIOSH has found no operations or process descriptions, or personnel monitoring data, related to WEC's commercial handling of uranium and thorium during these periods.

During residual radiation periods, the principal source of AWE-related internal radiation doses was the resuspension of surface contamination created from previous uranium and thorium operations.

NIOSH has determined that there was no potential for internal or external radiation doses from AWE-related residual contamination during the period from May 1, 2000 through March 1, 2011. Consequently, although the period from May 1, 2000 through March 1, 2011 is evaluated in this report, dose reconstruction is not required for this period. The following subsections address the ability to bound internal doses, methods for bounding doses, and the feasibility of internal dose reconstruction.

7.2.1 Evaluation of Bounding AWE Process-Related Internal Doses

NIOSH reviewed the AWE, commercial, and D&D activities at WEC and has an understanding of the AWE and D&D operations. However, NIOSH at this time does not have a sufficient understanding of WEC's uranium and thorium commercial radiological activities that were performed concurrently with AWE operations. NIOSH has been unable to locate internal monitoring data related to WEC commercial operations during the period from January 1, 1950 through April 30, 2000, including the two AWE operations periods. Radiation doses from commercial operations are required to be assessed during the site AWE operations periods. For this reason, NIOSH finds it is not feasible to estimate internal exposures with sufficient accuracy for all workers at the site during the period from February 1, 1958 through May 31, 1958, or during the period from June 1, 1959 through June 30, 1959.

NIOSH can however, for the purpose of partial dose reconstruction, bound AWE operational period process-related internal doses from uranium exposures using data from air monitoring during AWE operations, and using methodology as described in Battelle-TBD-6000 and OCAS-TIB-009, for the following operations during the period under evaluation:

- Operations associated with the uranium machining project for Fernald from May 12, 1958 through May 14, 1958
- Operations associated with the uranium machining project for Fernald from June 25, 1959 through June 29, 1959

Airborne Levels

NIOSH has reviewed a report of a HASL site visit conducted from May 12, 1958 through May 16, 1958. During the visit, HASL performed gross alpha air monitoring prior to work, during work, and after decontamination. HASL collected 7 breathing zone air samples that ranged from 3 to 6595 dpm/m^3 and 39 general area air samples that ranged from 1 to 4395 dpm/m^3. See Figure 7.1 for air dust sample results from this report. HASL also documented that a representative from Health and Safety should be present to evaluate the process and supervise the decontamination during subsequent test rollings at WEC (Ross, 1958).

NIOSH has also reviewed data from gross alpha air monitoring performed during subsequent rollings on June 25, 1959 through June 29, 1959. During these operations, 7 breathing zone air samples were collected that ranged from 185 to 5551 dpm/m^3 and 20 general area air samples that ranged from no detectable to 3816 dpm/m^3 (Monitoring, 1959). See Figures 7.2-7.5 for air dust sample results from this report.

Sample Description	No. of Samples	Concentration-α d/m/M³ High	Low	Average	X MAC
BZ Assel Mill operator during operation.	3	6595	2817	4690	67
BZ Taking tube from furnace and putting into Assel Mill.	4	384	3	170	2
GA Assel Mill operator's platform before any work was done.	5	5	1	2	0.02
GA Assel Mill operator's platform during operation of mill and stripper.	4	4395	704	2412	34
GA Assel Mill operator's platform immediately after operation of mill stopped.	4	213	11	136	2
GA Assel Mill before any work was done.	8	12	2	5	0.07
GA Assel Mill during rolling and stripping operations.	2	1830	1357	1594	23
GA Assel Mill after rolling and stripping operations stopped.	4	246	10	152	2
GA Argon furnace before any work was done.	2	23	1	12	0.17
GA Argon furnace during operations while putting in and taking out tubes.	2	32	14	23	0.33
GA Argon furnace after operations on furnace had stopped but Assel Mill operations were in progress.	1	----	----	18	0.25
GA Assel Mill 15 minutes after fire caused by burning of first test tube.	1	----	----	235	3
GA Assel Mill 30 minutes after fire caused by burning of first test tube.	1	----	----	8	0.11
GA Pulpit 15 minutes after fire caused by burning of first test tube.	1	----	----	93	1.3

Sample Description	No. of Samples	Concentration-α d/m/M³ High	Low	Average	X MAC
GA Argon furnace and Assel Mill Area after all clean-up and decontamination work was done.	4	14	10	12	0.17

MAXIMUM ALLOWABLE CONCENTRATION (MAC) - 70 α d/m/M³.

Source: Ross, 1958

Figure 7.1: Air dust sample results, May 12-16, 1958

Sample Description	R	T	Q	Count	Time	c/m	d/m/m3
GA Pulpit while heating and before rolling.	.02	15	.3	8	15.00	.26	3
GA Stripper while heating and before rolling.	.02	15	.3	5	18.27	nd	nd
GA At out end of mill - same conditions as above.	.02	15	.3	7	15.00	.20	2
GA At in end of mill - same conditions as above.	.02	15	.3	17	15.00	.86	10
GA On end of furnace - no ingot.	.02	15	.3	9	19.00	.20	2
GA On end of furnace while putting in first pipe.	.02	15	.3	7	15.00	.20	2
GA Same as 1376 - taking 1 pipe from furnace and putting into mill, starting mill and fire in mill.	.02	7	.14	3	15.00	nd	nd
GA In end of mill as in 1377.	.02	15	.3	24	15.00	1.33	15

Source: Monitoring, 1959

Figure 7.2: Air dust sample results, June 25, 1959

Sample Description	R	T	Q	Count	Time	c/m	d/m/m3
BZ Pulpit operator rolling one billet.	.02	4	.08	32	.40	79.73	3473
BZ Same as 2580 plus stripping.	.02	3	.06	32	.69	46.10	2677
GA Mill area while rolling and stripping.	.02	15	.3	32	.77	41.29	479
GA Inspection table immediately after rolling and stripping. Men inspecting tube.	.02	12	.24	32	4.35	7.09	10
GA Mill area while rolling and stripping.	.02	10	.2	320	1.27-	24.92	435
BZ Operator stripping after rolling.	.02	3	.06	320	1.68	18.78	1091
BZ Operator while rolling.	.o2	3	.06	32	75	42.40	2462

Source: Monitoring, 1959

Figure 7.3: Air dust sample results, June 25, 1959

Sample Description	R	T	Q	Count	Time	c/m	d/m/m3
GA At in end 1 hour after 3rd run. No activity in the area.	.02	15	.3	25	15.00	1.40	16
GA Same as above, except over out end.	.02	15	.3	8	15.00	.26	3
BZ Pulpit operator while rolling pipe.	.02	4	.08	32	.51	62.48	2721
BZ Same as 4976 plus stripping.	.02	2	.04	32	.50	63.73	5551
GA At in end of mill while rolling, stripping, and examining.	.02	20	.4	320	1.09	293.31	2555

Source: Monitoring, 1959

Figure 7.4: Air dust sample results, June 26, 1959

Sample Description	R	T	Q	Count	Time	c/m	d/m/m3
GA At out end of mill - same conditions as 1378.	.02	20	.4	320	.73	438.09	3816
GA At out end of mill 10 minutes after trying to pull mandril.	.02	15	.3	32	4.19	7.37	86
GA At out end of mill while vacuuming end of stripper. 1/2 hour after first pipe was made.	.02	15	.3	17	15.00	1.13	13
GA At furnace.	.02	15	.3	32	3.61	8.59	99
GA At in end of mill.	.02	15	.3	32	.50	63.73	740
GA At out end of mill while taking tube from furnace, cooling on tray, and attempting to roll.	.02	10	.2	32	9.36	3.08	54
BZ Taking dud ingot from rolls and attempting to strip.	.02	5	.1	32	5.73	5.31	185

Source: Monitoring, 1959

Figure 7.5: Air dust sample results, June 29, 1959

7.2.2 Evaluation of Bounding Residual Period Internal Doses

NIOSH can bound residual radiation period internal doses from uranium and thorium to WEC workers using data from air monitoring during AWE operations, and applying methodology as described in Battelle-TBD-6000, ORAUT-OTIB-0070, and OCAS-TIB-009, for the following periods during the class under evaluation:

- January 1, 1950 through January 31, 1958
- June 1, 1958 through May 31, 1959
- July 1, 1959 through April 30, 2000

7.2.3 Methods for Bounding Internal Dose at Westinghouse Electric Corp.

7.2.3.1 Methods for Bounding AWE Operational Period Internal Dose

All of the 1958/1959 AWE work was associated with uranium. Therefore, during these operations, all of the air monitoring gross alpha content is assumed to be uranium when estimating worker doses. NIOSH will derive the personal ingestion rates with methodologies presented in OCAS-TIB-009.

May 12, 1958 through May 16, 1958 Operations Period
NIOSH will use the maximum gross alpha air concentration sample (6595 dpm/m^3) collected during this period and apply it in a constant manner to model activity available for inhalation and ingestion by operator/rad production personnel.

June 25, 1959 through June 29, 1959 Operations Period
NIOSH will use the maximum gross alpha air concentration sample (5551 dpm/m^3) collected during this period and apply it in a constant manner to model activity available for inhalation and ingestion by operator/rad production personnel.

Bounding Method for Personnel Other Than Operator/Rad Production Personnel
NIOSH will use Battelle-TBD-6000 methodology to bound air concentrations for classes of workers with less exposure potential or that spent less time in the machining area than the operator/rad production personnel, as follows:

- For rad production support personnel, NIOSH will assume they were exposed to half the air concentration as that for the operator/rad production personnel.

- For personnel with primary responsibilities in the non-rad production area, NIOSH will assume they were exposed to half the air concentration as that for the rad production support personnel.

- For administrative /non-production area personnel, NIOSH will assume they were exposed to 10% of the air concentration as that for the personnel with primary responsibilities in the non-rad production area.

7.2.3.2 Methods for Bounding Residual Period Internal Dose

All of the air samples used to create these bounding methods were initially analyzed for gross alpha content; therefore, NIOSH will choose the most claimant-favorable mixture of thorium (from potentially the 1st operational period prior to 1950) or uranium when estimating worker doses. NIOSH will derive the personal ingestion rate with methodologies presented in OCAS-TIB-009.

January 1, 1950 through January 31, 1958 Residual Radiation Period
During the 2nd operational period, an on-site representative from HASL collected 15 general-area, gross-alpha air samples "before any work was done" (see Figure 7.1 above) (Ross, 1958). NIOSH will assume that the maximum average air sample from these 15 pre-work samples (12 dpm/m^3), is representative of the residual contamination generated during the first operational period and then was resuspended and available for sampling by HASL before any work was done during the subsequent operational period.

NIOSH will use the ORAUT-OTIB-0070 default depletion constant to model the build-up of this air concentration for each year back to January 1, 1950. This calculated amount of activity would have been available for inhalation and ingestion by personnel during each year of this residual radiation period.

June 1, 1958 through May 31, 1959 Residual Radiation Period
During the 2nd operational period, an on-site representative from HASL collected 4 general-area, gross-alpha air samples "after all clean-up and decontamination work was done" (see Figure 7.1 above) (Ross, 1958). NIOSH will assume that the average of these 4 samples (12 dpm/m^3) is representative of the air concentration at the start of this residual radiation period. Since the length of this residual radiation period is approximately one year, no source term depletion was applied. NIOSH will apply the air concentration of 12 dpm/m^3 in a constant manner to model activity available for inhalation and ingestion by personnel during this period.

July 1, 1959 through April 30, 2000 Residual Radiation Period
During the 3rd operational period, there were 27 gross-alpha air samples collected (see Figures 7.2-7.5 above) (Monitoring, 1959). NIOSH will use highest air sample (5551 dpm/m^3) collected during these operations, and use the settling and resuspension method presented in Battelle-TBD-6000 to estimate the airborne concentration at the beginning of the subsequent residual radiation period. The estimate of surface contamination will be made by assuming continuous settling of this airborne radioactive material at a rate of 0.00075 m/s for 5 days.

This settled activity is assumed to have been resuspended during ongoing moderate WEC operations with the application of a resuspension factor of 1 x 10^{-5} m^{-1} to provide an air concentration on July 1, 1959 for the start of the residual radiation period.

WEC operations did not generate any "new" airborne radioactivity from covered work after June 30, 1959. Therefore, NIOSH will deplete the July 1, 1959 airborne concentration down based on guidance in ORAUT-OTIB-0070. This amount of activity would have been available for inhalation and ingestion by personnel during each year of this period.

November 1, 1976 through April 30, 2000 D&D Activities
There is no remediation period listed for WEC in the DOE-HSS Facilities database, and NIOSH has found no indication that D&D was performed at DOE direction or expense. However, NIOSH is aware of several iterations of D&D that occurred with Building 7. Some of the D&D activities performed at WEC, as described in Section 5.1.1 of this report, utilized aggressive techniques such as scabbling, chipping, and grinding with air-operated tools. To estimate the exposures associated with these vigorous activities that increased contamination resuspension, NIOSH will increase the resuspension factor used in the residual radiation model during any D&D period from 1 x 10^{-5} m^{-1} to 1 x 10^{-4} m^{-1} to determine the amount of activity that would have been available for inhalation and ingestion by personnel. This modified resuspension factor was obtained using guidance from ORAUT-OTIB-0070 that shows increased resuspension rates for vigorous activities.

- For production area personnel, during the residual radiation periods there are no AWE-related radiological production operations; therefore, the intakes above for the residual radiation period will apply to all non-administrative workers in the production areas.

- For administrative/non-production area personnel, NIOSH will assume they were exposed to 10% of the air concentration as that for the personnel with primary responsibilities in the non-rad production area.

7.2.4 Internal Dose Reconstruction Feasibility Conclusion

NIOSH concludes that there are methods available in Battelle-TBD-6000, OCAS-TIB-009, and ORAUT-OTIB-0070, as well as available air data and operational descriptions, so that internal radiation doses can be completely reconstructed with sufficient accuracy for all AWE employees during the following periods under evaluation:

- All employees during the residual radiation period from January 1, 1950 through January 31, 1958
- All employees during the residual radiation period from June 1, 1958 through May 31, 1959
- All employees during the residual radiation period from July 1, 1959 through April 30, 2000

NIOSH does not have a sufficient understanding of the WEC uranium and thorium commercial radiological activities that were performed concurrently with AWE operations. NIOSH has been unable to locate internal monitoring data related to WEC commercial operations during the period from January 1, 1950 through April 30, 2000, including the two AWE operations periods. Radiation doses from commercial operations are required to be assessed during the site AWE operations periods. For this reason, NIOSH finds it is not feasible to estimate internal exposures with sufficient accuracy for all workers at the site during the period from February 1, 1958 through May 31, 1958, or during the period from June 1, 1959 through June 30. 1959.

NIOSH concludes that there are methods available in Battelle-TBD-6000, OCAS-TIB-009, and ORAUT-OTIB-0070, as well as available air data and operational descriptions, so that internal radiation doses can be fully reconstructed for the purpose of partial dose reconstructions for the following:

- AWE operations associated with the uranium machining project for Fernald from May 12, 1958 through May 14, 1958
- AWE operations associated with the uranium machining project for Fernald from June 25, 1959 through June 29, 1959

NIOSH does not have access to sufficient personnel monitoring, workplace monitoring, or source term data to estimate potential internal exposures to uranium and thorium associated with commercial operations during the period of AWE operations. Consequently, NIOSH finds that it is not feasible to estimate with sufficient accuracy internal exposures to uranium and thorium and resulting doses for Atomic Weapons Employees during the periods from February 1, 1958 through May 31, 1958, and June 1, 1959 through June 30. 1959.

Although NIOSH found that it is not possible to completely reconstruct internal radiation doses for the periods from February 1, 1958 through May 31, 1958, and June 1, 1959 through June 30. 1959, 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 Westinghouse Electric Corp. (New Jersey) during the

periods from February 1, 1958 through May 31, 1958, and June 1, 1959 through June 30. 1959, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

7.3 Evaluation of Bounding External Radiation Doses at Westinghouse Electric Corp.

During AWE operations periods (February 1, 1958 through May 31, 1958, and June 1, 1959 through June 30, 1959), the principal source of external radiation doses for members of the evaluated class was exposure to gamma and beta radiation associated with handling and working in proximity to uranium. Some employees were also potentially exposed to radiation from resuspended contamination from uranium- and thorium-contaminated surfaces and the floor during the course of their work.

During residual radiation periods, the principal source of AWE-related external radiation doses was the resuspension of surface contamination created from previous uranium and thorium operations, including radiation from uranium- and thorium-contaminated surfaces and the floor.

NIOSH has determined that there was no potential for internal or external radiation doses from AWE-related residual contamination during the period from May 1, 2000 through March 1, 2011. Consequently, although this report evaluates the period from May 1, 2000 through March 1, 2011, dose reconstruction is not required for this period. The following subsections address the ability to bound external doses, methods for bounding doses, and the feasibility of external dose reconstruction.

7.3.1 Evaluation of Bounding AWE Process-Related External Doses

NIOSH reviewed the AWE, commercial, and D&D activities at WEC and has an understanding of the AWE and D&D operations. However, NIOSH at this time does not have a sufficient understanding of WEC's uranium and thorium commercial radiological activities that were performed concurrently with AWE operations. NIOSH has been unable to locate external monitoring data related to WEC commercial operations during the period from January 1, 1950 through April 30, 2000, including the two AWE operations periods. Radiation doses from commercial operations are required to be assessed during the site AWE operations periods. For this reason, NIOSH finds it is not feasible to estimate external exposures with sufficient accuracy for all workers at the site during the period from February 1, 1958 through May 31, 1958, or during the period from June 1, 1959 through June 30, 1959.

NIOSH can however, for the purpose of partial dose reconstructions, bound AWE operational process-related external doses from uranium exposures using methodology as described in Battelle-TBD-6000 for the following operations during the period under evaluation:

- Operations associated with the uranium machining project for Fernald from May 12, 1958 through May 14, 1958
- Operations associated with the uranium machining project for Fernald from June 25, 1959 through June 29, 1959

Area Monitoring Data

NIOSH reviewed one 1958 AWE period document that shows that the uranium machining work area was decontaminated after operations were complete. A survey of the work area and mill showed that radiation levels were less than 0.1 mrep/hour beta gamma (Ross, 1958, PDF p. 4).

7.3.2 Evaluation of Bounding Residual Period External Doses

NIOSH can bound residual radiation period external doses from uranium and thorium to WEC workers using data from air monitoring during AWE operations, and applying methodology as described in Battelle-TBD-6000, ORAUT-OTIB-0070, and the Environmental Protection Agency's Federal Guidance Report No. 12, *External Exposure to Radionuclides in Air, Water, and Soil* (EPA-FGR-12), for the following periods during the class under evaluation:

- January 1, 1950 through January 31, 1958
- June 1, 1958 through May 31, 1959
- July 1, 1959 through April 30, 2000

7.3.3 Westinghouse Electric Corp. Occupational X-Ray Examinations

NIOSH examined available references and claim file records and found one 1942 document speaking of "active medical supervision" at Westinghouse Bloomfield. NIOSH has found no data relevant to medical X-rays at WEC during either AWE period under evaluation. Medical X-rays are not required to be considered during residual radiation periods. Per ORAUT-OTIB-0006 and ORAUT-OTIB-0079, in the absence of information to the contrary, NIOSH assumes that medical X-ray examinations were performed onsite during the AWE period.

NIOSH has determined that adequate reconstruction of medical X-ray dose is likely feasible using claimant-favorable assumptions in the technical information bulletins ORAUT-OTIB-0006 and ORAUT-OTIB-0079.

7.3.4 Methods for Bounding External Dose at Westinghouse Electric Corp.

There is an established protocol for assessing external exposure when performing dose reconstructions (these protocol steps are discussed in the following subsections):

- Photon Dose
- Beta Dose
- Neutron Dose
- Medical X-ray Dose (as applicable per Section 7.3.3)

7.3.4.1 Methods for Bounding AWE Operational Period External Dose

Photon Dose

Section 5.1 of this report discusses the quantity, size, and time periods that uranium rods were machined at WEC. Although no external personnel monitoring data are available to NIOSH for WEC employees, Table 6-1 of Battelle-TBD-6000 provides dose rates at the surface, one foot, and one meter from various uranium shapes, and will be used to bound the AWE operational period photon doses.

Beta Dose

Section 5.1.1 of this report discusses the quantity, size, and time periods that uranium rods were machined at WEC. Although no external personnel monitoring data are available to NIOSH for WEC employees, Table 6-3 of Battelle-TBD-6000 provides dose rates to the hands and forearm, and other skin from bare uranium metal, and will be used to bound the AWE operational period non-penetrating radiation doses.

Neutron Dose

Neutron exposures were not evaluated for WEC because they are negligible for natural-uranium metal-handling facilities (Battelle-TBD-6000) and for the residual quantities of thorium present during the evaluated period (ORAUT-OTIB-0024).

Medical X-ray Dose

NIOSH has not reviewed information that indicates medical X-ray examinations were NOT performed at WEC. Therefore, NIOSH will assume that pre-employment, annual, and termination PA radiographic chest X-ray screenings were performed for workers. NIOSH will bound doses using ORAUT-OTIB-0006.

7.3.4.2 Methods for Bounding Residual Period External Doses

Although no external personnel monitoring data are available to NIOSH for WEC, residual period radiation doses can be bound by using the air concentrations modeled in Section 7.2.3.2 of this report, ORAUT-OTIB-0070, and EPA-FGR-12 to model the doses from contaminated surfaces and air submersion.

7.3.5 External Dose Reconstruction Feasibility Conclusion

NIOSH concludes that there are methods available in Battelle-TBD-6000, EPA-FGR-12, and ORAUT-OTIB-0070, as well as available air data and operational descriptions, so that external radiation doses can be completely reconstructed with sufficient accuracy for all AWE employees during the following periods under evaluation:

- All employees during the residual radiation period from January 1, 1950 through January 31, 1958
- All employees during the residual radiation period from June 1, 1958 through May 31, 1959
- All employees during the residual radiation period from July 1, 1959 through April 30, 2000

NIOSH does not have a sufficient understanding of the WEC uranium and thorium commercial radiological activities that were performed concurrently with AWE operations. NIOSH has been unable to locate external monitoring data related to WEC commercial operations during the period from January 1, 1950 through April 30, 2000, including the two AWE operations periods. Radiation doses from commercial operations are required to be assessed during the site AWE operations periods. For this reason, NIOSH finds it is not feasible to estimate external exposures with sufficient accuracy for all workers at the site during the period from February 1, 1958 through May 31, 1958, or during the period from June 1, 1959 through June 30, 1959.

NIOSH concludes that there are methods available in Battelle-TBD-6000, EPA-FGR-12, and ORAUT-OTIB-0070, as well as available air data and operational descriptions, so that external radiation doses can be fully reconstructed for the purpose of partial dose reconstructions for the following:

- AWE operations associated with the uranium machining project for Fernald from May 12, 1958 through May 14, 1958
- AWE operations associated with the uranium machining project for Fernald from June 25, 1959 through June 29, 1959

NIOSH does not have access to sufficient personnel monitoring, workplace monitoring, or source term data to estimate potential external exposures to uranium and thorium associated with commercial operations during the period of AWE operations. Consequently, NIOSH finds that it is not feasible to estimate with sufficient accuracy external exposures to uranium and thorium and resulting doses for Atomic Weapons Employees during the periods of February 1, 1958 through May 31, 1958, and June 1, 1959 through June 30, 1959.

Although NIOSH found that it is not possible to completely reconstruct external radiation doses for the period from February 1, 1958 through May 31, 1958, and June 1, 1959 through June 30. 1959, NIOSH intends to use any external 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 Westinghouse Electric Corp. (New Jersey) during the period from February 1, 1958 through May 31, 1958, and June 1, 1959 through June 30. 1959, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

7.4 Evaluation of Petition Basis for SEC-00217

The following subsections evaluate the assertions made on behalf of petition SEC-00217 for Westinghouse Electric Corp.

7.4.1 Lack of Pre-1976 Survey Data

Assertion: *During the period, 1950 to 1976, no radiation readings were taken. The first testing of WEC facilities occurred in 1976.*

Response: NIOSH was able to locate some survey data from commercial and MED operations during the period from 1950 to 1976 and have included those data in Section 6 of this report.

7.4.2 Lack of Pre-1976 External Dosimetry

Assertion: *The employees did not wear monitoring badges for exposures during the period from 1950 to 1976.*

Response: NIOSH currently has not located copies of any monitoring records. However, NIOSH was able to locate the following: license requirements for external personal monitoring, reports where AEC inspectors reviewed the monitoring records and documented the highest doses, and documents indicating that film badges were read monthly by Landauer. NIOSH also interviewed D&D workers that witnessed the use of these dosimeters during their work.

7.5 Summary of Feasibility Findings for Petition SEC-00217

This report evaluates the feasibility for completing dose reconstructions for employees at Westinghouse Electric Corp. (New Jersey) from January 1, 1950 through March 1, 2011. NIOSH found that the available monitoring records, process descriptions, and source term data available are not sufficient to complete dose reconstructions for all of the evaluated class of employees.

Information obtained by NIOSH as part of this evaluation, allowed for updates to the site residual contamination status (see Section 5.1.2). Based on the sum of site remediation information from available resources, including interviews of site experts, NIOSH has determined that there was no potential for internal or external radiation doses from AWE-related residual contamination during the period from May 1, 2000 through March 1, 2011. Consequently, although the period from May 1, 2000 through March 1, 2011 is evaluated in this report, dose reconstruction is not required for this period.

Table 7-1: Summary of Feasibility Findings for SEC-00217
This table spans multiple pages.

Source of Exposure	Reconstruction Feasible	Reconstruction Not Feasible
January 1, 1950 through January 31, 1958 (residual radiation period)		
Internal	**X**	
External	**X**	
- Gamma	X	
- Beta	X	
- Occupational Medical X-ray	N/A	
Source of Exposure	**Reconstruction Feasible**	**Reconstruction Not Feasible**
February 1, 1958 through May 31, 1958 (AWE operations)		
Internal		**X[1]**
External		**X[1]**
- Gamma		X
- Beta		X
- Occupational Medical X-ray	X	

Table 7-1: Summary of Feasibility Findings for SEC-00217 *This table spans multiple pages.*		
Source of Exposure	**Reconstruction Feasible**	**Reconstruction Not Feasible**
June 1, 1958 through May 31, 1959 (residual radiation period)		
Internal	**X**	
External	**X**	
- Gamma	X	
- Beta	X	
- Occupational Medical X-ray	N/A	
Source of Exposure	**Reconstruction Feasible**	**Reconstruction Not Feasible**
June 1, 1959 through June 30, 1959 (AWE operations)		
Internal		**X[2]**
External		**X[2]**
- Gamma		X
- Beta		X
- Occupational Medical X-ray	X	
Source of Exposure	**Reconstruction Feasible**	**Reconstruction Not Feasible**
July 1, 1959 through April 30, 2000 (residual radiation period)		
Internal	**X**	
External	**X**	
- Gamma	X	
- Beta	X	
- Occupational Medical X-ray	N/A	
Source of Exposure	**Reconstruction Feasible**	**Reconstruction Not Feasible**
May 1, 2000 through March 1, 2011 (previously defined residual radiation period)		
Internal	**N/A[3]**	
External	**N/A[3]**	
- Gamma	N/A	
- Beta	N/A	
- Occupational Medical X-ray	N/A	

Notes:

[1] For the purpose of partial dose reconstruction, NIOSH is able to reconstruct doses for AWE operations associated with uranium machining for Fernald from May 12, 1958 through May 16, 1958. NIOSH is unable to reconstruct doses associated with non-AEC commercial operations during the period from February 1, 1958 through May 31, 1958.

[2] For the purpose of partial dose reconstruction, NIOSH is able to reconstruct doses for AWE operations associated with uranium machining for Fernald from June 25, 1959 through June 29, 1959. NIOSH is unable to reconstruct doses associated with non-AEC commercial operations during the period from June 1, 1959 through June 30, 1959.

[3] NIOSH had determined the site was decontaminated sufficiently for unrestricted release on April 30, 2000. NIOSH has determined that there was no potential for internal or external radiation doses from AWE-related residual contamination during the period from May 1, 2000 through March 1, 2011.

As of March 4, 2015, a total of 41 claims have been submitted to NIOSH for individuals who worked at Westinghouse Electric Corp. during the period under evaluation in this report. Dose reconstructions have been completed for 37 individuals (~90%).

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 Westinghouse Electric Corp. (New Jersey) during the period from February 1, 1958 through May 31, 1958, or during the period from June 1, 1959 through June 30. 1959, 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-00217

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

Based on the sum of information found in available resources, NIOSH's evaluation determined that it is not feasible to estimate radiation dose with sufficient accuracy for members of the NIOSH-evaluated class during the period from February 1, 1958 through May 31, 1958, or during the period from June 1, 1959 through June 30. 1959. Therefore, the resulting NIOSH-proposed SEC class must include a minimum required employment period as a basis for specifying that health was endangered for these time periods. NIOSH has determined that members of the class were not exposed to radiation during a discrete incident likely to have involved levels of exposure similarly high to those occurring during nuclear criticality incidents. Consequently, NIOSH is specifying that health was endangered for those workers 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.

NIOSH further determined that it is feasible to estimate radiation dose with sufficient accuracy for members of the NIOSH-evaluated class during the period from January 1, 1950 through January 31, 1958, and from June 1, 1958 through May 31, 1959, and from July 1, 1959 through April 30, 2000. Therefore, a health endangerment determination is not required for these time periods.

9.0 Class Conclusion for Petition SEC-00217

Based on its full research of the class under evaluation, NIOSH has defined a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. The NIOSH-proposed class to be added to the SEC includes all Atomic Weapons Employees who worked at the facility owned by Westinghouse Electric Corp. (New Jersey) in Bloomfield, New Jersey, during the period from February 1, 1958 through May 31, 1958, or during the period from June 1, 1959 through June 30. 1959, 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 included in the Special Exposure Cohort.

NIOSH had determined that there are methods available in NIOSH procedures, as well as available workplace and air data and operational descriptions, so that internal and external radiation doses can be completely reconstructed with sufficient accuracy for all AWE Employees during the following periods under evaluation:

- The residual radiation period from January 1, 1950 through January 31, 1958
- The residual radiation period from June 1, 1958 through May 31, 1959
- The residual radiation period from July 1, 1959 through April 30, 2000

Information obtained by NIOSH as part of this evaluation allows for updates to the site residual contamination status. Based on the sum of site remediation information from available resources, including interviews of site experts, NIOSH has determined that there was no potential for internal or external radiation doses from AWE-related residual contamination during the period from May 1, 2000 through March 1, 2011. Consequently, although the period from May 1, 2000 through March 1, 2011 is evaluated in this report, dose reconstruction is not required for this period.

NIOSH has carefully reviewed all material sent in by the petitioner, including the specific assertions stated in the petition, and has responded herein (see Section 7.4). NIOSH has also reviewed available technical resources and many other references, including the Site Research Database (SRDB), for information relevant to SEC-00217. In addition, NIOSH reviewed its NOCTS dose reconstruction database to identify EEOICPA-related dose reconstructions that might provide information relevant to the petition evaluation.

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

10.0 References

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

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

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

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Attachment One: Data Capture Synopsis

Table A1-1: Summary of Holdings in the SRDB for Westinghouse Electric Corp. (New Jersey)			
Data Capture Information	**Data Capture Description**	**Completed**	**Uploaded into SRDB**
Primary Site/Company Name: Westinghouse Electric Corporation AWE 1942 -1949; February-May 1958; June 1959; Residual Radiation 1950-March 1, 2011 Alternate Site Names: North American Phillips Lighting Physical Size of the Site: The site size is approximately 14 acres and had 11 buildings, all of which have been demolished. Population of the Site: In 1966, 55 workers participated in the site film badge program.	Records from the Westinghouse collection at the Senator John Heinz History Center, Pittsburgh, PA were reviewed including: A general chronology of Westinghouse accomplishments, history of the Lamp Division Facility, and a uranium processing discussion.	12/20/2007	17
State Contacted: NJ Department of Environmental Radiation	Westinghouse Bloomfield final radiological surveys, a final radiological status survey, a radiological dose assessment, cleanup plans, building floor plans, source material license permit, summary of history, a 1969 list of radioactive material license possession limits, and radiological status of the former MED/AEC sites.	02/18/2015	49
Albany Research Center	A report on the production and separation of U-233.	03/20/2013	1
Ames Laboratory	A history of Ames' contributions to the Manhattan Engineer District which mentions uranium from Westinghouse, Bloomfield.	10/18/2005	1
Curtiss-Wright, Cheswick PA	Radiation exposure records and occupation exposure histories, 1960-1972.	04/29/2009	2
DOE Germantown	Air samples, FUSRAP reports, thorium information and accountability reports, and the search procedures for the Oak Ridge Operations Records Holding Area.	03/07/2011	8
DOE Legacy Management - Grand Junction	Description of the photochemical production of U metal, radiological status of Westinghouse facilities used in the Manhattan Project, uranium metal production, metallurgical progress reports, FUSRAP reports, trip reports, budget reports, an accountability report, and source material license SMB-353 including amendments and correspondence.	07/22/2013	87
DOE Legacy Management - Morgantown	Summary technical reports, a list of sites, an ALARA Committee report, and a report on the production of uranium feed materials.	04/05/2011	5

Table A1-1: Summary of Holdings in the SRDB for Westinghouse Electric Corp. (New Jersey)			
Data Capture Information	**Data Capture Description**	**Completed**	**Uploaded into SRDB**
DOE Legacy Management - MoundView (Fernald Holdings, includes Fernald Legal Database)	Report on incineration of radioactive solid wastes, a thorium report, various trip reports, and depleted uranium shipment information.	05/30/2008	13
DOE Oak Ridge Operations Office	A list of papers written on uranium.	11/24/2003	1
DOE Oak Ridge Operations Office Records Holding Task Group (RHTG)	The Special Nuclear Materials Ledger for 1955-1959.	04/05/2011	1
DOE Office of Scientific and Technical Information (OSTI)	Uranium metal development at Bloomfield in 1942, and the electrolytic process for uranium metal.	01/23/2012	2
Federal Record Center - Kansas City	1942-1946 weekly reports and the FUSRAP elimination report.	08/15/2008	2
Federal Record Center - San Bruno	Medical Health Physics quarterly reports from 1949 and 1950 and studies of the metabolism of plutonium and fission products.	07/27/2012	3
Hagley Museum and Library	A November 1951 New York Operations Office trip report.	09/28/2010	1
Hanford	A Plutonium Finishing Plant (PFP) report identifying Westinghouse as having shipped scrap to PFP.	04/27/2009	1
Interlibrary Loan	Volume 1 of Seaborg's journal.	03/26/2012	1
Internet - Comprehensive Epidemiologic Data Resource (CEDR)	No relevant documents identified.	02/12/2015	0
Internet - Defense Technical Information Center (DTIC)	A report on metallurgy in the development of atomic power.	02/24/2015	1
Internet - DOE Hanford Declassified Document Retrieval System (DDRS)	A 1949 Hanford Works monthly report, and a nuclear monitoring system report.	02/24/2015	2
Internet - DOE Legacy Management Considered Sites	NRC inspections, a DOE response to a request for information on Fernald subcontractors, and an attorney's letter listing pertinent documents.	02/03/2015	4
Internet - DOE National Nuclear Security Administration (NNSA) - Nevada Site Office	No relevant documents identified.	02/12/2015	0
Internet - DOE OpenNet	Monthly status and progress reports from 1949, Manhattan District History Book I General Volume 7 Medical Program, Linking Legacies Appendix B: The Eight Major Processes of the Nuclear Weapons Complex, an AEC financial report, and an Idaho National Laboratory Health Physics report.	02/03/2015	6
Internet - DOE OSTI	An interim report on the metallurgy of thorium and thorium alloys, 1949-1951.	11/02/2006	1
Internet - DOE OSTI Energy Citations	No relevant documents identified.	04/06/2008	0
Internet - DOE OSTI Information Bridge	The metal fabrication program for the Clinton Engineer Works and reports on nuclear reactors built, under construction, or planned.	08/26/2012	4
Internet - DOE OSTI SciTech Connect	No relevant documents identified.	02/03/2015	0

Table A1-1: Summary of Holdings in the SRDB for Westinghouse Electric Corp. (New Jersey)			
Data Capture Information	**Data Capture Description**	**Completed**	**Uploaded into SRDB**
Internet - Energy Employees Claimant Assistance Project (EECAP)	No relevant documents identified.	02/12/2015	0
Internet - Google	General information, Westinghouse Electrical Company evaluation of residual contamination, Westinghouse and World War II news article, historical articles, an NRC inspection, Material License SMB-1527, Amendment 1, and a history of uranium production at Bloomfield.	03/19/2015	27
Internet - Health Physics Journal	No relevant documents identified.	02/12/2015	0
Internet - Journal of Occupational and Environmental Health	No relevant documents identified.	02/12/2015	0
Internet - National Academies Press (NAP)	No relevant documents identified.	02/03/2015	0
Internet - NEPIS	No relevant documents identified.	02/03/2015	0
Internet - NIOSH	Reports on residual radioactive and beryllium contamination at Atomic Weapons Employer facilities and the SEC-00159 Petition Evaluation Report.	09/20/2012	4
Internet - NRC Agencywide Document Access and Management (ADAMS)	Various status and release radiological surveys, safety evaluation report, release for unrestricted use of Bloomfield Lamp Plant buildings 1-6 and the garage, status of the decommissioning program reports, a dose assessment, the 1996 response to the radiological document submittal, license correspondence, and amendments to USNRC license number SMB-1527.	02/03/2015	45
Internet - Oak Ridge National Laboratory (ORNL)	ORNL periodic reports mentioning Westinghouse Bloomfield.	12/18/2012	15
Internet - USACE	No relevant documents identified.	02/03/2015	0
Internet - Washington State University (U.S. Transuranium and Uranium Registries)	No relevant documents identified.	02/03/2015	0
National Archives and Records Administration (NARA) - Atlanta	Field progress reports, process instructions, weekly reports, thorium related correspondence, production reports, billet shipment receipts, and Burns vs. Westinghouse lawsuit.	05/12/2010	24
National Archives and Records Administration (NARA) - College Park	Beryllium reports, Manhattan District History Book V Electromagnetic Project Volume 2 Research, and a 1948-1949 thorium accountability report.	09/11/2013	3
National Archives and Records Administration (NARA) - Kansas City	Preliminary radiological surveys, historical information on FUSRAP sites, and a listing of Oak Ridge Operations Office.	04/01/2005	4
National Archives and Records Administration (NARA) - Seattle	A shipment record of U-235 and irradiated hafnium.	12/18/2014	1
National Institute for Occupational Safety and Health (NIOSH)	Volumes I and II of the History of the Atomic Energy Commission, the 1948 fourth Semiannual Report to Congress, the memorandum of understanding between Westinghouse and the University of Chicago for the	12/02/2014	5

Table A1-1: Summary of Holdings in the SRDB for Westinghouse Electric Corp. (New Jersey)			
Data Capture Information	**Data Capture Description**	**Completed**	**Uploaded into SRDB**
	production of uranium metal, and the coverage of Westinghouse Bloomfield under EEOICPA.		
New York State Archives	Manhattan District History Book VII Feed Materials excerpts.	03/19/2012	1
Nuclear Regulatory Commission (NRC) Public Document Room	AEC/NRC Licenses SMB-1423, 47-21279-01, SMB-353, STB-467, 29-20609-02, and R-126, license correspondence, license inspections, air sample data, and an environmental assessment and finding of no significant impact related to License No. SMB-1527.	09/26/2014	59
Oak Ridge Library for Dose Reconstruction	A 1949 and a 1953 ORNL Operations Division reports mentioning Westinghouse Bloomfield.	04/05/2011	2
Oak Ridge National Laboratory (ORNL)	ORNL periodic reports mentioning Westinghouse Bloomfield.	03/20/2014	33
ORAU Team	A report confirming that some Westinghouse Bloomfield employee health records were in a "Rochester File" in 1981 and documented communications.	03/09/2015	9
Phillips Electronics North America	Phillips Electronics response to a request for data, thorium contamination in a sample from a mercury cleanup, a survey instrument certificate of calibration, a timeline of decontamination efforts, a decontamination proposal and bid, and a filed QA/QC manual.	06/18/2013	6
SAIC	A 1960 radiation exposure summary.	09/02/2004	1
Savannah River Site	Listings of classified reports received in 1957.	06/06/2011	3
Southern Illinois University	A book discussing radioactive wastes disposed in the St. Louis area.	10/08/2008	1
Unknown	NYOO status reports, FUSRAP documents referring to Westinghouse Bloomfield performing work for Fernald, records of material transfers, thorium receipts, trip reports, and a contractor index.	02/10/2011	28
Total			**484**

Table A1-2: Database Searches for Westinghouse Electric Corp. (New Jersey)			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
NOTE: Database search terms employed for each of the databases listed below are available in the Excel file called "Westinghouse Electric Corp Rev01, (83.14) 03-24-15."			
Defense Technical Information Center (DTIC) https://www.dtic.mil/ COMPLETED 02/24/2015	See Note above	460	0
DOE CEDR http://cedr.lbl.gov/ COMPLETED 02/12/2015	See Note above	0	0
DOE Legacy Management Considered Sites http://csd.lm.doe.gov/ COMPLETED 02/03/2015	See Note above	115	1
DOE Hanford DDRS http://www2.hanford.gov/declass/ COMPLETED 02/24/2015	See Note above	0	0
DOE NNSA - Nevada Site Office www.nv.doe.gov/main/search.htm COMPLETED 02/12/2015	See Note above	1	0
DOE OpenNet http://www.osti.gov/opennet/advancedsearch.jsp COMPLETED 02/03/2015	See Note above	566	0
DOE OSTI Energy Citations http://www.osti.gov/energycitations/ COMPLETED 04/06/2008	See Note above	459	0
DOE OSTI Information Bridge http://www.osti.gov/bridge/advancedsearch.jsp COMPLETED 01/21/2008	See Note above	177	1
DOE OSTI SciTech Connect http://www.osti.gov/scitech COMPLETED 02/03/2015	See Note above	631,588	0
Energy Employees Claimant Assistance Project (EECAP) http://www.eecap.org COMPLETED 02/12/2015	See Note above	0	0
Google http://www.google.com COMPLETED 02/03/2015	See Note above	23,306,090	16

Table A1-2: Database Searches for Westinghouse Electric Corp. (New Jersey)			
Database/Source	**Keywords**	**Hits**	**Uploaded into SRDB**
HP Journal http://journals.lww.com/health-physics/pages/default.aspx COMPLETED 02/12/2015	See Note above	5	0
Journal of Occupational and Environmental Health http://www.ijoeh.com/index.php/ijoeh COMPLETED 02/12/2015	See Note above	21	0
National Academies Press http://www.nap.edu/ COMPLETED 02/03/2015	See Note above	16,233	0
NEPIS http://nepis.epa.gov/ COMPLETED 02/03/2015	See Note above	18,590	0
NRC ADAMS Reading Room http://www.nrc.gov/reading-rm/adams/web-based.html COMPLETED 02/03/2015	See Note above	4,266	29
United States Army Corps of Engineers (USACE) http://www.usace.army.mil/ COMPLETED 02/03/2015	See Note above	2	0
United States Army Corps of Engineers (USACE) - New England District http://www.nae.army.mil/ COMPLETED 02/03/2015	See Note above	2	0
United States Army Corps of Engineers (USACE) - New York District http://www.nan.usace.army.mil/ COMPLETED 02/03/2015	See Note above	2	0
United States Army Corps of Engineers (USACE) - Philadelphia District http://www.nap.usace.army.mil/ COMPLETED 02/03/2015	See Note above	2	0
U.S. Transuranium & Uranium Registries http://www.ustur.wsu.edu/ COMPLETED 02/03/2015	See Note above	0	0