SEC Petition Evaluation Report
Petition SEC-00043

Report Rev # 0 Report Submittal Date 8-08-06

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Site Expert(s):	
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Petition Administrative Summary			
Petition Under Evaluation			
Petition #	Petition Type	Qualification Date	DOE/AWE Facility Name
SEC-00043	83.13	November 9, 2005	Chapman Valve Manufacturing Company

Feasible to Estimate Doses with Sufficient Accuracy?											
Single Class				Multiple Classes				Determination Established for All Classes			
Yes		No	X	Yes	X	No		Yes		No	X

Petitioner Class Definition
Guards, captain of guards, chief inspectors, inspectors, engineers, master mechanics, heat treater foremen, steamfitters, machine repairers, assistant to director of research, steam fitting and plumbing maintenance foremen, machine shops and maintenance general superintendents, electricians, chief electricians, milling machine operators, centerless grinder operators, portable grinder machinists, chipper machinists, assemblers, tool crib machinists, turret lathe operators, janitors, janitor helpers, decontamination workers, firefighters, and general foremen who worked at Chapman Valve Manufacturing Company in Indian Orchard, Massachusetts, from 1948 through 1949 and from 1991 through 1995 (DOE Remediation).

Proposed Class Definition
All AWE employees who were monitored, or should have been monitored, for radiological exposures while performing Atomic Energy Commission work in Building 23 at the Chapman Valve Manufacturing Company in Indian Orchard, Massachusetts, from January 1, 1948, through December 31, 1949, and from January 1, 1991, through December 31, 1993.

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

Related Evaluation Report Information	
Report Title	DOE/AWE Facility Name

ORAU Lead Technical Evaluator: (Document Owner)	**[Signature on file]** *Ray Clark*	**8/08/06** *Date*
Peer Review Completed By:	**[Signature on file]** *Mark Rolfes*	**8/30/06** *Date*
SEC Petition Evaluation Reviewed By:	**[Signature on file]** *Jim Neton*	**8/30/06** *Date*
SEC Evaluation Approved By:	**[Signature on file]** *Larry Elliott*	**8/31/06** *Date*

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Evaluation Report Summary: SEC-00043, Chapman Valve

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 USC (EEOICPA) and 42 CFR 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*.

<u>Petitioner Requested Class Definition</u>

Petition SEC-00043, qualified on November 9, 2005, requested that NIOSH consider the following class: *Guards, captain of guards, chief inspectors, inspectors, engineers, master mechanics, heat treater foremen, steamfitters, machine repairers, assistant to director of research, steam fitting and plumbing maintenance foremen, machine shops and maintenance general superintendents, electricians, chief electricians, milling machine operators, centerless grinder operators, portable grinder machinists, chipper machinists, assemblers, tool crib machinists, turret lathe operators, janitors, janitor helpers, decontamination workers, firefighters, and general foremen who worked at Chapman Valve Manufacturing Company in Indian Orchard, Massachusetts, from 1948 through 1949 and from 1991 through 1995 (DOE Remediation).*

<u>NIOSH Proposed Class Definition</u>

Based on its research, NIOSH modified the petitioner-requested class to define a single class of employees for which NIOSH can estimate radiation doses with sufficient accuracy. This proposed class includes: All AWE employees who were monitored, or should have been monitored, for radiological exposures while performing Atomic Energy Commission work in Building 23 at the Chapman Valve Manufacturing Company in Indian Orchard, Massachusetts, from January 1, 1948, through December 31, 1949, and from January 1, 1991, through December 31, 1993.

For the purposes of this evaluation, the period from January 1, 1948, through April 30, 1949, is evaluated as the operational period; the periods from May 1, 1949, through December 31, 1949, and from January 1, 1991, through December 31, 1993, are evaluated as residual radioactivity periods. The latter period of the petitioner-requested class was reduced from 1991 through 1995 to 1991 through 1993 in order to expedite the evaluation of this SEC Petition. The 1994-1995 period will be evaluated as a Remediation Period and the development of a dose reconstruction method in the Chapman Valve Technical Basis Document for this period has been reserved pending further research. NIOSH is continuing to evaluate the 1994-1995 remediation period and available data for Chapman Valve, and will address this period in an addendum to this Evaluation Report.

<u>Feasibility of Dose Reconstruction</u>

Per EEOICPA and 42 CFR § 83.13(c)(1), NIOSH has established that it has access to sufficient information to: (1) estimate the maximum radiation dose incurred by any member of the class; or (2) estimate radiation doses more precisely than a maximum dose estimate. Information available from the site profile and additional resources are sufficient to document or estimate the maximum internal and external potential exposure to members of the proposed class under plausible circumstances during the specified period.

<u>Health Endangerment Determination</u>

Per EEOICPA and 42 CFR § 83.13(c)(3), a health endangerment determination is not required because NIOSH has determined that it has sufficient information to estimate dose for the members of the proposed class.

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SEC Petition Evaluation Report for SEC-00043

1.0 Purpose and Scope

This evaluation report documents the feasibility of reconstructing doses for all Atomic Weapons Employer employees who were monitored, or should have been monitored, for radiological exposures while performing Atomic Energy Commission work in Building 23 at the Chapman Valve Company from January 1, 1948, through April 30, 1949, and from 1991 through 1993. 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 provide 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 does not document the final determination as to whether or not 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 CFR 83, and the guidance contained in the Office of Compensation Analysis and Support's *Internal Procedures for the Evaluation of Special Exposure Cohort Petitions,* OCAS-PR-004.

2.0 Introduction

The EEOICPA and 42 CFR 83 require NIOSH to evaluate qualified petitions requesting the Department of Health and Human Services (HHS) to add a class of employees to the SEC. The evaluation is intended to provide a fair, science-based determination of whether or not it is feasible to estimate with sufficient accuracy the radiation doses for members of the proposed class of employees.[1]

42 CFR § 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 CFR § 83.13(c)(3), if it is not feasible to estimate with sufficient accuracy radiation doses for members of the class, NIOSH must also make a determination whether or not there is a reasonable likelihood that such radiation doses may have endangered the health of members of the class. The regulation requires NIOSH to assume that any duration of unprotected exposure may have endangered the health of members of a class when it has been established that the class may have been exposed to radiation during a discrete incident likely to have involved levels of exposure similarly high to those

[1] NIOSH dose reconstructions under EEOICPA are performed using the methods promulgated under 42 CFR 82 and the detailed implementation guidelines available at www.cdc.gov/niosh/ocas.

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 either solely under the employment or in combination with work days within the parameters established for other SEC classes (excluding aggregate workday requirements).

NIOSH is required to document the petition evaluation in a report. For development of the evaluation report, NIOSH relies on its own dose reconstruction expertise as well as technical support from Oak Ridge Associated Universities Team (ORAUT). Upon completion, the report is provided to the petitioners and to the Advisory Board on Radiation and Worker Health. The Board will consider the NIOSH evaluation report, together with the petition, petitioner(s) comments, and other information the Board considers appropriate, to make recommendations to the Secretary of HHS on whether or not to add one or more classes of employees to the SEC. Once NIOSH has received and considered the advice of the Board, the Director of NIOSH will propose decisions on behalf of HHS. The Secretary of HHS will make final decisions, taking into account the NIOSH evaluation, the advice of the Board, and the proposed decisions and recommendations of the Director of NIOSH. Following this decision process, petitioners may seek a review of certain types of final decisions issued by the Secretary of HHS.[2]

3.0 Petitioner Requested Class/Basis and NIOSH Proposed Class/Basis

Petition SEC-00043, qualified on November 9, 2005, requested that NIOSH consider the following class: *Guards, captain of guards, chief inspectors, inspectors, engineers, master mechanics, heat treater foremen, steamfitters, machine repairers, assistant to director of research, steam fitting and plumbing maintenance foremen, machine shops and maintenance general superintendents, electricians, chief electricians, milling machine operators, centerless grinder operators, portable grinder machinists, chipper machinists, assemblers, tool crib machinists, turret lathe operators, janitors, janitor helpers, decontamination workers, firefighters, and general foremen who worked at Chapman Valve Manufacturing Company in Indian Orchard, Massachusetts, from 1948 through 1949 and from 1991 through 1995 (DOE Remediation).*

The petitioner provided information and affidavit statements in support of the petitioner's belief that sufficiently accurate dose reconstruction over time is not possible because: (1) personnel were not monitored through personal or area monitoring; (2) monitoring records have been lost, falsified, or destroyed; or (3) there is no monitoring, source term, or process-related information for the site. NIOSH considered the following information and affidavit statements sufficient to qualify SEC-00043 for evaluation.

> The documentation provided by the petitioner (SECIS document IDs: 9185 and 9248) in support of SEC petition 00043 (SECIS document ID: 9184) asserted that: (1) there were only three periods (33 samples) of available bioassay monitoring for the AEC contract period at Chapman Valve, and there is no data to support why these samples were collected; (2) there is insufficient data to support the determination of a plausible upper

[2] See 42 CFR 83 for a full description of the procedures summarized here. Additional internal procedures are available at www.cdc.gov/niosh/ocas.

bound dose estimate (there is a lack of monitoring data and a lack of process and source term information); (3) there is insufficient data regarding a documented uranium fire in May-June 1948; (4) the Chapman Valve Site Profile does not account for the potential of enriched uranium; (5) the Chapman Valve Site Profile does not account for potential exposures at the cracking furnace and the uranium chip incinerator, or the potential for a uranium-rolling operation; and (6) there is only one day of uranium air-sample data; (7) there is no assumption in the Chapman Valve Site Profile to address the potential for uranium fires or the potential frequency of uranium fires.

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.

NIOSH modified the petitioner-requested class considered in this current evaluation report to include all AWE employees who were monitored, or should have been monitored, for radiological exposures while performing Atomic Energy Commission work in Building 23 at the Chapman Valve Manufacturing Company in Indian Orchard, Massachusetts, from January 1, 1948, through December 31, 1949, and from January 1, 1991, through December 31, 1993. For the purposes of this evaluation, the period from January 1, 1948, through April 30, 1949 is evaluated as the operational period; the periods from May 1, 1949, through December 31, 1949, and from January 1, 1991, through December 31, 1993, are evaluated as residual radioactivity periods. The latter period of the petitioner-requested class, from 1994 through 1995, will be evaluated as a Remediation Period. The development of a dose reconstruction method for this period in the Chapman Valve Technical Basis Document has been reserved pending further research. NIOSH's evaluation of the 1994-1995 remediation period, and the available data for Chapman Valve, will be addressed in an addendum to this Evaluation Report.

4.0 Data Sources Reviewed by NIOSH

NIOSH identified and reviewed data sources to determine the availability of information relevant to determining the feasibility of dose reconstruction for the class of employees proposed for this petition. This included determining the availability of information on personal monitoring, area monitoring, industrial processes, and radiation source materials. The following sections summarize the data sources identified and reviewed.

4.1 Site Profile/Technical Basis Documents (TBDs)

A Site Profile/Technical Basis Document provides specific information concerning the documentation of historical practices at the specified site. Dose reconstructors can use the Site Profile/Technical Basis Document to aid in the interpretation of internal and external personal monitoring data. The Site Profile/Technical Basis Document also provides methodologies for evaluating potential radiation doses for unmonitored workers. It may serve as a supplement to, or substitute for, individual monitoring data. As part of this evaluation, the following TBD was reviewed:

- *Technical Basis Document: Basis for the Development of an Exposure Matrix for Chapman Valve Manufacturing, Indian Orchard, Massachusetts, Period of Operation: January 4, 1948 through April 30, 1949;* ORAUT-TKBS-0033; February 22, 2005

4.2 ORAU Technical Information Bulletins (OTIBs)

An ORAU Technical Information Bulletin (OTIB) is a general working document that provides guidance concerning the preparation of dose reconstructions at particular sites or categories of sites. NIOSH reviewed the following OTIBs describing the dosimetry program at Chapman Valve, as well as the use of co-worker data to fill in gaps in monitoring information for some employees and timeframes:

- *OTIB: Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures;* ORAUT-OTIB-0006, Rev. 2; December 21, 2005

- *OTIB: Estimating the Maximum Plausible Dose to Workers at Atomic Weapons Employer Facilities;* ORAUT-OTIB-0004, Rev 03, November 18, 2005

4.3 Facility Employees and Experts

NIOSH conducted phone interviews with four former Chapman Valve Manufacturing Company employees. The documented information associated with these interviews has been compiled in NIOSH's SEC Information System (SECIS). The former employees were asked the following questions about the AEC operations related to uranium work at Chapman:

1. Where did you work in the operation? Did you work in the set aside "nuclear/atomic area" of Building 23?

2. Can you describe the operations in the nuclear area? Were the operations limited to uranium machining or were there uranium-rolling operations?

3. Do you recall a furnace in the set aside area? Do you recall what it was used for? (Could it have been a cracking furnace or a chip incinerator?)

4. Do you recall what they did with the nuclear scrap or turnings/shavings?

5. Are there any other details you would like to add?

All four individuals worked in the restricted area in Building 23 at Chapman Valve. As indicated from the interviews, their job titles/duties included work as a metalsmith in the maintenance group, work as a sandblaster/gritblaster/grinder, work in support of turning, cutting, milling, and drilling operations, and work as a crane rigger and equipment operator. The common consensus of the four interviewees was that, based on their recollection of the uranium operations at Chapman Valve, only machining and grinding operations were performed. None of the interviewees could recall any operations associated with uranium rolling. There were varied responses regarding the existence of a 'cracking' furnace at Chapman. Three of the four individuals recalled/discussed variations of a furnace "at the end of the building" with the description of operations ranging from an incinerator to a casting furnace to a heat-treatment furnace.

The responses regarding the disposition of the scrap trimmings/shavings was inconclusive, although one interviewee stated that the chips/shavings/cuttings were placed in the furnace "and reheated to make additional product."

In addition to the phone interviews conducted with the four former employees, the comments and responses related to the Chapman Valve worker outreach meeting were reviewed for this report. The information provided in the documentation from this meeting, is generally consistent with the information/responses provided by the four interviewees discussed above.

4.4 Previous Dose Reconstructions

NIOSH reviewed its dose reconstruction database, NIOSH OCAS Claims Tracking System (NOCTS), to identify dose reconstruction cases under EEOICPA that might provide information relevant to the petition evaluation. As of May 1, 2006, NIOSH had received a total of 106 individual claims for the Chapman Valve Manufacturing Company that fell within the timeframe identified in the proposed class definition. Table 4-1 provides a results summary of this review for the January 1, 1948, through December 31, 1949; and from January 1, 1991, through December 31, 1993, timeframes.

Table 4-1: Chapman Valve Claims Submitted Under Dose Reconstruction Rule

(01-01-48 through 12-31-49; and 01-01-91 through 12-31-93)

(Data available as of: May 1, 2006)

Description	Totals
Total number of cases submitted for energy employees who meet the proposed class definition criteria	106
Number of dose reconstructions completed for energy employees who were employed during the years identified in the proposed class definition	91
Number of cases for which internal dosimetry records were obtained for the identified years in the proposed class definition	5
Number of cases for which external dosimetry records were obtained for the identified years in the proposed class definition	9

NIOSH reviewed each claim to determine whether internal and/or external personal monitoring records could be obtained for the employee. Computer Assisted Telephone Interviews (CATIs) were conducted with the intent of obtaining additional information relevant to the individual claim, such as work locations, hours, job titles, and other information.

As part of the dose reconstruction process, the CATIs were carefully reviewed for relevant information. To the extent that it related to the individual claims reviewed for this evaluation, the interviews provided some useful information for dose reconstructions (i.e., work locations, hours worked, and hazards encountered).

4.5 NIOSH Site Research Database

The NIOSH site research database was reviewed for documents to support the evaluation of the proposed class. This database contains some useful information for Chapman Valve, including: dose rate survey reports, film badge records, urinalysis data, radiological control program descriptions, air monitoring data, 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:

1. Petition Form B and supporting information provided within the petition; SECIS document ID: 9184; received August 23, 2005.

2. E-mail correspondence dated April 22, 2005, petition-supporting documentation that includes job titles from urine data sheets (as Attachment 1); SECIS document ID: 9185; received August 23, 2005.

3. Map of Building 23, petition-supporting documentation cover sheet (as Attachment 2) and map (as separate document); SECIS document IDs: 9185 and 9338; received August 23, 2005, and November 21, 2005, respectively.

4. Draft meeting minutes from NIOSH Dose Reconstruction Project Meeting on the Chapman Valve Site Profile conducted on February 14, 2005; petition-supporting documentation (as Attachment 3); SECIS document ID: 9185; received August 23, 2005.

5. Excerpt from *Results of Radiological Survey at the Former Chapman Valve Manufacturing Company, Indian Orchard, Massachusetts* (CIO001), ORNL/RASA-92/1, issued July 1992; R. D. Foley, M. S. Uziel; petition-supporting documentation (as Attachment 4); SECIS document ID: 9185; received August 23, 2005.

6. Memo from W. E. Kelly to Walter J. Williams, Date Unreadable, re: SF Materials Lost or Unaccounted For; petition-supporting documentation (as Attachment 5); SECIS document ID: 9185; received August 23, 2005.

7. Affidavit provided by the petitioner dated September 15, 2005 (directly related to the information provided in the Petition Form B); SECIS id: 9248; received September 23, 2005.

5.0 Radiological Operations Relevant to the Proposed Class

The following subsections summarize the radiological operations at the Chapman Valve Manufacturing Company from January 1, 1948, to April 30, 1949; and the activities with the potential for residual radioactivity exposures from May 1, 1949, through December 31, 1949, and from January 1, 1991, through December 31, 1993. These discussions include information available to NIOSH for characterizing the radiological processes and source terms during these periods. NIOSH has gathered information regarding the identity and quantities of the radionuclides of concern, the processes through which radiation exposures may have occurred, and the physical environment in which exposures may have occurred. The information included within this evaluation report is only a summary of the available information.

5.1 Chapman Valve Facility and Process Descriptions

The Chapman Valve Manufacturing Company was a principal supplier of regular and special valves and manifolds for the Manhattan Engineer District [MED] (Young, 1987). AEC (Y-12 Plant) contracts with Chapman identified to date include: W-22-0705-eng-64 [dated 1/5/49], W-7401-eng-38, 136, and 137 [dated 4/20/48] (Contracts); and W-7412-eng-1 [1943 valve order] (Chapman, 1943). Records also indicate that Chapman Valve, under contract with the Brookhaven Laboratory, machined uranium metal during the period January through November, 1948 (Young, 1987).

The Chapman Valve main office and works were located on Hampshire Street in Indian Orchard, Massachusetts. Uranium shipments were made to Oak Street and claims refer to [uranium] operations in the building on Pine Vale Street (ORAUT-TKBS-0033).

In 1947, Chapman set aside approximately one-third of Department No. 40 in the western end of Building 23 at the Chapman Plant Site, 203 Hampshire Street, Indian Orchard, Massachusetts, to engage in a uranium program for Brookhaven National Laboratory (BNL) (Chapman, 1996). This part of the facility was separated from the remainder of the building by a floor-to-ceiling wooden partition and measured approximately 200-feet long by 60-feet wide. The ceiling was more than 50-feet high (Dvorchak, 1987).

Correspondence pertaining to the radiological history of the site indicates that the AEC established a health and safety program at the Chapman facility. Workers in the AEC area of Building 23 were required to wear white coveralls and badges while in the special work area (Dvorchak, 1987). Area access controls were in place. These controls are not clearly associated with job categories, but were an issue of both security and contamination control. An affidavit from a former Chapman Valve employee describes some of the radiological safety controls (Ungerland, 1987). According to the affidavit, workers removed their clothes and donned white coveralls prior to entering the uranium manufacturing area. Workers wore dosimeters on their uniforms and inspectors passed through the site carrying Geiger counters. At the completion of a day’s work, the employees returned to the dressing room and removed their white coveralls. Each employee was then required to take a shower as a safety measure.

Preparation for the BNL uranium machining effort may have begun in November, 1947, with the initiation of health and safety programs (Wolf, 1947). An inventory report indicated that Chapman Valve had less than 50 pounds of uranium as of January, 1948 (Morgan, 1948). Actual production may not have started until May, 1948, but a set of contamination measurements from March, 1948, indicates that start-up activities may have begun earlier (LeVine, 1948). Records indicate that machining operations ceased in November, 1948, and all identified uranium materials and scrap was sent off site before the end of the year (Fiore 1987). The Chapman Site Profile assumes that the material was on site through April 30, 1949, which was the end of Electro Metallurgical's reporting period regarding Chapman Valve uranium processing (discussed further below).

Twenty-six tons of uranium rods were sent to the Chapman Valve Oak Street facility on January 9, 1948 (Fiore, 1987). On January 15, 1948, Wolf wrote, "A survey of proposed uranium machining operation…" indicating that the facility had not yet started machining production quantities of uranium (Wolf, 01-21-48). In an April 28 to May 5, 1948, weekly report Wolf states, "Health and safety preparations at the Chapman Valve plant in Indian Orchard, Mass., for the proposed machining operation were investigated by the Radiation Survey and Safety Sections," indicating the facility still had not begun machining as of May 5, 1948 (Wolf, 05-06-48).

After the production period ended, Chapman Valve had over 27,000 pound of metal scrap, oxides, and sweepings, which were to be shipped off site (ORNL/RASA-92/1). A Crane Company letter noted that there was correspondence indicating that all radioactive residues and contaminated material had been shipped off of the site as of December, 1948 (the Crane Company purchased Chapman Valve in 1959 and discontinued all manufacturing early in 1987). Another note indicates that the "27,000 pounds of metal scrap, oxides, sweepings, etc., were shipped off site several months after the contract was complete." Other documentation is unclear regarding whether another shipment of source and fissionable material would be made after January 25 (Morgan, 1949). An enclosure to Fiore and ORNL state that Chapman Valve had in their possession over 27,000 pounds of metal scrap, oxides, sweeping, etc., for several months beyond completion of the contract (Fiore, 1987 and ORNL/RASA-92/1). Both documents refer to a Chapman Valve letter dated November 8, 1948, that requested termination of AEC film badge services and indicated that all radioactive residues were surveyed by Brookhaven Medical Group and shipped off site in December, 1948. The Electro Metallurgical Division of U.C. & C. Corp. was contracted to process Chapman Valve material and scraps. About 28,000 pounds of metal from Chapman are mentioned in the Electro Metallurgical weekly production report dated April 1 through April 30, 1949, indicating that the final shipment would have been no later than April 30, 1949 (Electro, 1949). Thus the Chapman Valve radiological operational period is assumed to have ended no later than April 30, 1949, with only residual radioactivity addressed after that date.

Once the AEC operations were completed at Chapman, all associated equipment was removed and the area cleaned and surveyed (Chapman, 1996). As indicated in the ORNL July 1992 Chapman Valve radiological survey report (ORNL/RASA-92/1), the Chapman Valve Indian Orchard site became part of the Crane Company in 1959. The 1992 report indicates that at the time of the survey, Building 23 had been vacant since the cessation of all operations at the former Chapman Valve site in 1987. For the purposes of this evaluation, the period of post-April 30, 1949 Chapman Valve operations, up to the commencement of remediation operations in 1994, is considered a residual radioactivity period.

5.2 Radiological Exposure Sources from Chapman Valve Operations

Records indicate that Chapman Valve, under contract with the Brookhaven Laboratory, machined uranium metal during the period January, 1948, through November, 1948, although machining of production quantities probably did not begin until May, 1948. As indicated in the Dvorchak affidavit, "During the course of operations uranium rods were brought to the facility by railroad car on a track which ran immediately adjacent to the building. The (uranium) rods were cut by a mechanical saw and then machined to the shape requested by the customer" (Dvorchak, 1987).

Based on the reviews of the documentation for Chapman Valve (including data related to operations and associated radiological monitoring data), Chapman uranium operations were associated with the machining of natural uranium for BNL. The indication that only machining operations were performed is supported by the job title information in the dosimetry records provided for Chapman Valve (Musgrave, 1948; AEC 05-06-48).

As part of the development of the Chapman Valve TBD, the Chapman Valve uranium internal exposure scenarios associated with operations were compared to similar operations at other sites (i.e., Y-12 and Simonds Saw and Steel). (Because film badge data are available for Chapman Valve workers, further evaluation of external exposures based on workplace data or comparisons to operations at other sites was not performed.) The Simonds Saw and Steel site was used for internal exposures comparison for Chapman radiological operations because of Simonds' larger volume of uranium work, abundance of monitoring data, and the similarity of its source term and operations in 1948. Simonds primarily performed rolling operations with natural uranium from 1948 through 1956; however, those operations did include grinding and forging processes. The Y-12 site was used for internal exposures comparison based on large-scale uranium machining operations in the same period as the Chapman Valve machining operations, although the source term for Y-12 machining operations was primarily depleted uranium.

Based on the review of operations-related documents, the source of internal radiation exposure at Chapman Valve was uranium dust produced from the manipulation of metals during machining and related processes. The source of external radiation was associated with working in close proximity to uranium metal and containers/drums of uranium wastes (turnings, shavings, contaminated waste materials, etc.).

Chapman had set aside approximately one-third of Department No. 40 in Building 23 of the Chapman Plant Site, 203 Hampshire Street, Indian Orchard, Massachusetts, to engage in this program (Ungerland, 1987). Uranium rods were brought to the facility by railroad on a track immediately adjacent to the building. The uranium operations performed at Chapman resulted in airborne contamination in Building 23, as indicated by the bioassay and airborne radioactivity measurements during the 1948 operations, and by the surface contamination of the area reported by the 1992 Building 23 residual contamination pre-remediation radiological survey (ORNL/RASA-92/1). As discussed in Section 7.4.1.5, the uranium was of natural enrichment. There was no indication that recycled uranium was processed at Chapman Valve (recycled uranium did not enter process streams until at least 1952). Available documentation indicates that Chapman Valve's 1948-1949 uranium work for Bechtel National, Inc., (BNI) was confined to Building 23 and the adjacent railcar area. The restricted, uranium operations portion of Building 23 was separated from the remainder of the Building by a floor to ceiling wooden partition. Individuals were admitted to the restricted portion of this building/department by a guard (Chapman, 1996). A residual radioactivity period existed at Chapman Valve after the end of operations in April, 1949, until 1994 when remediation activities commenced under BNI management.

Records mention a fire in the restricted area of the AEC project, which probably occurred in early June, 1948 (Fox, 1949). The exact nature of the fire and extent of the damage is unknown, although records indicate two people (guards) put out the fire and five people (foreman, captain of the guards, and three helpers) were involved in the cleanup. There is no indication that off-site firefighters were contacted to assist in containment of the fire. The involvement of uranium metal in the fire is suggested by a Chapman Valve letter dated January 19, 1949, that indicates urine samples were taken from the men who fought and put out the fire, and the men who were involved in the clean-up process. The monitoring data available from this incident are discussed further in Section 6.1.

5.2.1 Alpha Particle Emissions

Alpha particle emissions from the radioactive materials handled at the Chapman Valve facility presented the greatest potential for exposure through internal deposition via inhalation and ingestion (alpha particles do not present an external exposure hazard). The principal alpha-emitting radioactive material associated with Chapman Valve operations was natural uranium. Processed natural uranium consists of approximately equal activities of uranium-238 [4.20 MeV and 4.15 MeV alpha particles] and uranium-234 [4.77 MeV and 4.72 MeV alpha particles] (Radiological Health, 1970). There are smaller amounts of uranium-235 (approximately 1/20 of the activity levels of uranium-238 or uranium-234) with alpha particles of 4.40 MeV and 4.36 MeV.

5.2.2 Beta Radiation Fields

Beta radiation was the dominant external source of radiation associated with activities involving contact with unshielded sources of uranium, such as the uranium machining processes at Chapman Valve. The dominant beta radiation from natural uranium is from the uranium-238 decay products. The most energetic of these beta particles is 2.29 MeV from protactinium-234m. The beta dose rate from the surface of a uranium slab is on the order of 230 millirad (mrad) per hour.

5.2.3 Neutron Exposures

Neutron exposures are not evaluated for Chapman Valve because they are negligible for natural uranium metal-handling facilities (ORAUT-OTIB-0004).

5.2.4 Photon Exposures

The majority of photons from natural uranium metals are in the 30 to 250 keV energy range. In contrast, 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 billet or rod) to have energies greater than 250 keV. While the solid uranium sources at this facility were likely to have a hardened photon spectrum, exposure to a thin layer of uranium on surfaces, whenever that occurred, would have resulted in a larger fraction of exposure to lower-energy photons, in the 30 to 250 keV range. This evaluation assumes that workers were exposed entirely to lower-energy photons, which is claimant favorable (ORAUT-TKBS-0033).

6.0 Summary of Available Monitoring Data for the Proposed Class

NIOSH has personal and area monitoring data in the NIOSH Site Research Database (SRDB) which have been used to estimate doses to individual employees in the proposed class. The results of NIOSH data reviews are provided in the following subsections.

6.1 Chapman Valve Internal Monitoring Data

As discussed in Section 5.2, the primary source of internal radiation exposure at Chapman Valve was uranium dust produced from the manipulation of metals during machining and related processes. Chapman Valve internal monitoring data are available to evaluate these potential exposures for the operation period (Urine, 1948). After the conclusion of uranium machining operations and clean-up in 1948, no additional bioassay data were collected (there would have been no regulatory reason to obtain further internal monitoring data from the point in time when uranium operations ceased up to the commencement of remediation activities, which occurred after the evaluation period of this report).

NIOSH analyzed results from four sets of bioassay samples (urinalyses) during the development of the Chapman TBD dose reconstruction method. This included the seven bioassay samples taken on June 11, 1948, after (and in response to) the fire and samples collected on July 26-27, September 8-9, and October 7 of 1948 from 22, six, and five workers, respectively (ORAUT-TKBS-0033). The job titles associated with the bioassay samples are listed in Table 5-1. There is no information in the sample report that indicates why the samples were taken. Further evaluation of this data is included in Sections 7.1 and 7.2 of this evaluation report.

Table 5-1: Job Titles Associated with 1948 Chapman Valve Bioassay Samples

Asst. to Director of Research	Heat Treater - Foreman
Captain of Guards	Helper
Centerless Grinder	Helper - Janitor
Chief Electrician	Helper - Weighing
Chief Inspector	Inspector
Electrician	Inspector - H. K. Ferguson Co.
Engineer	Machine Repair
Foreman	Master Mechanic
Foreman, Steam Fitting & Plumbing Maintenance	Milling Machine Operator
Foreman - Substitute	Personnel Manager
Gen. Superintendent, Machine Shops & Maintenance	Steamfitter
Guard	Turret Lathe Operator

For the post-April 30, 1949, residual contamination period, there is an indication that radiological surveys were performed: (1) in 1949, after cleaning/decontamination activities (post-operation) (Chapman, 1996); (2) in 1987, after all operations were discontinued at the site (Sedelow, 1987b); and (3) in 1991, as referred to in a letter discussing a radiological survey (Williams, 1991). However, no survey data are available for any of these surveys. Internal exposure assessment methods have been developed in the Chapman Valve TBD (ORAUT-TKBS-0033) based on the available radiological survey data from a 1992 ORNL radiological survey of Building 23 (ORNL/RASA-92/1).

6.2 Chapman Valve External Monitoring Data

Chapman Valve reported the following ancillary information regarding film badge availability and use during the uranium machining operations period (Musgrave, 1948):

- February 2, 1948: Received 50 (brass) badges from the University of Rochester.
- February 9, 1948: Received duplicate shipment (with identical numbers) noted to be the pin-type dosimeters.
- April 28, 1948: Requested 100 badges and subsequently received 100 stainless steel snap-on badges from the University of Rochester.
- May 10, 1948: Returned the 50 used brass pin-type dosimeters and 50 used stainless steel snap-on badges to the University of Rochester.
- May 18, 1948: Received 100 stainless steel snap-on badges and noted that Chapman Valve would like to continue this badge type.
- May 19, 1948: Sent 50 brass pin-type and 50 stainless steel snap-on badges to AEC in New York per AEC request.

Less than 50 film badge results are included in each reporting period, most likely indicating that only some of the workers entered the AEC work are in a given week. A note at the bottom of the May reports states "Eastman Film," but does not mention the type of film (ORAUT-TKBS-0033).

In the Chapman Valve records, exposure for both beta and gamma were reported in "mr" in 1948. There are 81 individual film badge assignments and 1365 external dosimetry results for Chapman Valve employees reported for the weeks from May 3, 1948, through November 1, 1948. The reporting limit, as indicated in the film badge records, was 50 mR for beta and for gamma radiation. These data were reviewed in the development of the Chapman Valve TBD to identify the median and maximum reported results for each week (ORAUT-TKBS-0033).

As indicated in Section 5.1, production level machining activities were most likely performed from May, 1948, through November, 1948. However, the first reported shipment of uranium in the form of rods ready to be machined was on January 9, 1948. Uranium in the form of floor sweepings, turnings, and shavings were on site after the completion of machining operations, possibly as late as April 30, 1949. These pre- and post-operational periods, for which monitoring data does not exist, have been treated for the purposes of dose reconstruction as operationally-unmonitored periods (ORAUT-TKBS-0033). As discussed in Section 7.3.1, the available operational period monitoring data have been used to establish bounding exposure scenarios for the unmonitored period for the dose reconstructions completed to date.

NIOSH has not found any information regarding AEC-required physical examinations for Chapman Valve employees. The AEC usually, but not always, required "pre-employment" and periodic medical examinations of workers involved in the larger uranium-processing programs. The term "pre-employment," as used here, means prior to performing AEC-contracted radiological work. The typical AEC medical program included a preliminary and annual chest X-ray examination. NIOSH has data to characterize the radiological exposures associated with such examinations (ORAUT-OTIB-0006).

For the post-April 30, 1949, residual contamination period, there is an indication that radiological surveys were performed: (1) in 1949, after cleaning/decontamination activities (post-operation) (Chapman, 1996); (2) in 1987, after all operations were discontinued at the site (Sedelow, 1987b); and (3) in 1991, as referred to in a letter discussing a radiological survey (Williams, 1991). However, no survey data are available for any of these surveys. External exposure assessment methods have been developed in the Chapman Valve TBD (ORAUT-TKBS-0033) based on the available radiological survey data from a 1992 ORNL radiological survey of Building 23 (ORNL/RASA-92/1).

6.3 Chapman Valve Air Sampling Data

The AEC provided air sampling analyses for samples collected at Chapman Valve on May 4, 1948, and May 24, 1948 (AEC, 05-06-48; AEC, 06-01-48). The May 4, 1948, sample results are measurements of the effluent from a furnace outlet on the roof of Building 23. The May 24, 1948, results are 10-minute samples listed as "Inspection Bench, Packing Bench, Work Bench, Wash Room, and Lunch Room." These samples are not directly used in determining worker intakes in the dose reconstructions completed to date because it is not clear how these samples relate to worker activities. As an estimate, however, an inhalation intake was calculated by assuming that the maximum result reported (29.1 dpm alpha/m^3 measured at the workbench) was the concentration for the entire work year. Upward adjustment of this number to account for the increased workload in the summer months, as well as accounting for ingestion, results in an intake value that is consistent with the intake value determined from bioassay results.

NIOSH has identified no air sample data from its reviews of the available data for the post-April 30, 1949, residual radioactivity period.

7.0 Feasibility of Dose Reconstruction for the Proposed Class

The feasibility determination for the proposed class of employees covered by this evaluation report is governed by EEOICPA and 42 CFR § 83.13(c)(1). Under this Act and rule, NIOSH must establish whether or not it has access to sufficient information to either, 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, then it would be determined that it was feasible to conduct dose reconstructions.

In making determinations of 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 (identified in Section 7.5 of this report). If not, NIOSH systematically evaluates the sufficiency of different types of monitoring data, process and source or source term data, which together or individually might assure NIOSH can estimate either the maximum doses 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 specified in the SEC Petition Evaluation Internal Procedures (OCAS-PR-004) available at www.cdc.gov/niosh/ocas.

The evaluation that follows examines separately the availability of information necessary for reconstructing internal and external radiation doses of members of the proposed class.

7.1 Sufficiency of Chapman Valve Data

Chapman Valve machined natural uranium under an Atomic Energy Commission contract in 1948. As discussed in Section 5.2 of this report, the potential for radiological exposures associated with the machining of uranium rods, and from containers/drums of uranium wastes (turnings, shavings, contaminated waste materials, etc.), is assumed to have existed at Chapman Valve from January 1, 1948, until April 30, 1949. During the main machining period from May to November, 1948, workers were monitored for occupational radiation exposure and monitoring records are available. All other periods outside of the main machining period have been considered unmonitored periods (either unmonitored operational periods or residual radiation periods) for the purposes of dose reconstructions conducted to date.

The AEC (Wolf, 1947) planned the initial health and safety controls and monitoring at Chapman Valve: “On November 24 [1947], a conference was held with Chapman Valve and Ferguson personnel as a result of which a complete set of health and safety recommendations were made a few days later in writing.” To monitor external exposure, 100 film badges were provided each week (Musgrave, 1948). The existence of an AEC health and safety program at the Chapman Valve facility was also documented in a letter from Crane (Crane, 1987; page 8).

Area access controls were in place at Chapman Valve and were applicable to all job categories. These controls were in place for security, contamination, and radiation exposure control purposes (Ungerland, 1987). Although access control records and AEC reports provide evidence of a radiation control program, no formal documentation of the program was found. Because bioassay data and film badge data were used to estimate internal and external doses at Chapman Valve during the AEC operations (ORAUT-TKBS-0033), it was not necessary to estimate the number of workdays or work-hours for the January 1, 1948, through April 30, 1949, period. For the purpose of estimating post-operational/residual radioactivity exposures (for the post-April 30, 1949, period), it was assumed that workers worked 8 hours per day, 50 weeks per year, for an annual total of 2000 hours.

The following subsections evaluate the data in terms of sufficiency for establishing bounding exposure scenarios for the proposed class. The review focuses on the available personnel monitoring data used in the development of the Chapman Valve TBD and this evaluation report.

7.1.1 Pedigree of Data

7.1.1.1 External Data Review

For this evaluation report, NIOSH compared the three files containing individual external monitoring data that were used in the development of the Chapman TBD (SRDB Ref IDs: 10749, 14131, and 16436). Based on this review, NIOSH concluded that file 16436 appeared to be a copy of an original handwritten documentation of the individual monitoring data for the operational period from May to November, 1948. The file contains weekly external monitoring data listed by badge number and/or individual name/job title. In addition, the file contains some reports of individual hours spent in the restricted area, although reports were not found for all days for which external monitoring was performed.

There is also a 'cleaned-up' (mostly typed) version of the handwritten film badge results in files 10749 and 14131. NIOSH has determined that files 10749 and 14131 contain duplicate data (i.e., the same document scanned at different levels of visual quality). The 'cleaned-up' version was verified to contain the same data as the handwritten version with the following differences: (1) the 'cleaned-up' version only contains the individual monitoring data, not the work-hour information; and (2) the 'cleaned-up' version eliminates lines that contain no data or where there is an indication that badges were not used for a particular period.

These files document that a total of 81 different individuals were assigned badges at Chapman Valve and includes 27 weeks of monitoring data. Badges were exchanged on a weekly basis. NIOSH compared the data transcriptions from the original handwritten files to the 'cleaned-up' versions and found them to be accurate. The only differences in these data are that un-quantified doses, indicated with an 'X' (which NIOSH interprets to be a dose that was less than the minimum detectable dose), were not always transcribed into the typed versions (they were left blank). The maximum weekly doses documented were 650 mR non-penetrating and 110 mR penetrating for the May – November 1948 period. The median beta result for May, 1948, was (115 mR) and the reporting limit specified on the Chapman Valve reports for gamma (50mR) were used to estimate the exposure for weeks when film badges were not in use or for weeks when the data were blank.

For the post-April 30, 1949, residual radioactivity period, NIOSH reviewed the file containing the radiological survey data used in the development of the residual radioactivity portion of the Chapman TBD (ORNL/RASA-92/1). The source documentation associated with this survey was not available; therefore, an internal comparison of this data was not possible.

7.1.1.2 Internal Data Review

NIOSH reviewed for this evaluation the file containing individual internal monitoring data used in the development of the Chapman TBD (SRDB Ref ID: 6235). An internal comparison of the data after June, 1948, was not possible because no other source bioassay files were available for Chapman Valve.

As part of the data sufficiency review, NIOSH also considered the urine data for individuals involved in the fire of June, 1948 (SRDB Ref ID: 12730), for which bioassay results had redacted names. There are seven samples - from two workers involved in putting out the fire, and from five workers involved in clean-up. These results are the same as the June 11, 1948, results in an un-redacted file containing fire follow-up bioassay data (SRDB Ref ID: 6325). These results thus comprise a single source of data; therefore, an internal data comparison was not possible.

7.1.2 Credibility and Consistency of Data

7.1.2.1 External Data Review

The three files discussed in Section 7.1.1.1 (SRDB Ref IDs: 10749, 14131, and 16436) were reviewed to evaluate data credibility and consistency. Other than the discrepancies described in Section 7.1.1.1, no other issues were identified during the reviews and comparisons performed by NIOSH for this evaluation report. All three files contain essentially the same data/pages, with the smallest file a refinement of the previous two. File number 16436 is the most comprehensive, 14131 is the initial refinement, and 10749 is a re-scanned copy of 14131. File number 16436 has 1778 entries in the Last Name column and 1365 values in the exposure column (including lines marked with “none,” indicating that a badge was not worn). File number 14131 has 1404 entries in the Last Name column and 781 values in the exposure column. The files were cross-checked in a variety of ways. The discrepancies in the data comparison also reflect the difference in source document quality. Data transfers from 16436 to 10749 were compared and are accurate. The only discrepancies noted were the transfer of doses of < 50 mR which were sometimes left as no entries.

Based on the review of the external dosimetry files (Section 7.1.1.1), all job titles listed in the SEC petition are represented in external monitoring data, with the exceptions of Assembler, Decontamination Worker, and Firefighter. The source of the job titles listed in the petition is not known and cannot be ruled out as slang terms or terms that represented an actual work activity. Based on a review of the petition documentation, the job title “assembler” appears as a title for one of the (deceased) former energy employees represented in the petition. As indicated in the former energy employee’s individual claim file, the title listed is “assembling,” which appears to a description of work instead of a job title. This former energy employee also had the title of “valve machinist” listed in the petition. Based on this review, machinists would appear to be a reasonable representation for “assembling” or “assembler” work, as evaluated in this report. Decontamination work could have been performed by any of the job titles listed in the petition but was likely performed by the helpers and is not expected to be a primary job title during the Chapman operational years (i.e., it is more a description of the work performed). The potential for the existence of this job title, for radiological decontamination work, is more likely in the post-April 30, 1949, residual contamination period evaluated in this report. This job title is most likely to apply to the 1994-1995 remediation period, which is not being evaluated in this report. It does not appear that a job title of firefighter was associated with the AEC uranium work; workers who put out the June, 1948, fire were either guards, helpers, or a foreman.

The Chapman data have been reviewed to identify the maximum results for each week. The median beta result for May, 1948, (115 mR) and the reporting limit specified on the Chapman Valve reports for gamma (50mR) were used to estimate the exposure for weeks with no film badge results.

7.1.2.2 Internal Data Review

Chapman Valve uranium urinalysis data (Urine 1948) consist of 40 uranium urinalysis results from 37 workers (three workers have two results each). Bioassay results are available for seventeen of the twenty-six job titles listed in the petition are covered by the bioassay samples.

Simonds Saw and Steel was a larger uranium-handling AWE operating in 1948 with comparable activities involving rolling, grinding, and forging. AEC-contracted Y-12 operations during the period involved even larger amounts of uranium with comparable activities that included machining. Bioassay data from these two sites were compared to the Chapman Valve bioassay data. No Y-12 bioassay data were available for 1948; the earliest readily-available data was for 1952. To expedite the comparison, the Y-12 data from the month with the largest geometric mean was selected. (Records indicate that although there are Y-12 uranium urinalyses for 1950 and 1951, results are lower than for 1952; operations might have been curtailed, and there were concerns about the particular analytical methods used at Y-12.) Y-12 data was reported in terms of daily uranium activity in urine, so results were converted to ug/L, assuming a uranium specific activity of 0.683 pCi/ug, and an excretion of 1.4 liters per day.

The amount of uranium handled by Simonds Saw and Steel in the late 1940s was likely to be at least 10 times the amount handled by Chapman Valve. Sometime in 1949, Simonds ramped up to process about 150,000 lbs. of uranium per month, which is more than three times the amount of uranium processed by Chapman between January and July of 1948. It is suspected that Chapman processed less than 300,000 lbs. total and might have processed no more than 141,200 lbs. The throughput of uranium at Y-12 is likely to also have been larger than at Chapman. The information from these comparisons is included in Table 7-1.

Although seven bioassays were collected as a result of the fire at Chapman, fires were not rare at uranium processing facilities during the early years; co-worker data from all sites would include bioassay related to incidents as well as normal operations. The geometric means and GSDs were based on ranking and fitting the natural log of the bioassay results to a line, as is done for the associated co-worker studies. It should also be noted that for Chapman, when all results were below the detection threshold in a given sampling period, the detection threshold was used for fitting the intakes.

Table 7-1: Comparison of Bioassay Data for Y-12, Simonds Saw and Steel, and Chapman Valve				
Comparison Topic	**Chapman**	**Simonds**	**Simonds**	**Y-12**
Period of monitoring considered	1948	1948-1952	1948 only	1952 (April)
Number of uranium urinalyses	40	645	67	-
Geometric mean (ug/L)	7	8	17	12
GSD	2.34	3.06	2.08	2.91
95th percentile (ug/L)	30	51	58	70
Percentage of bioassay results ≤40ug/L	95%	96%	91%	-
Range of geometric means for each sampling period (ug/L)	7 to 17	1 to 27	11 to 22	-
Percentage of results >40 ug/L	5%	4%	9%	-

The Simonds and Y-12 uranium urinalyses provide comparable datasets of results for uranium metal handling activities. The Chapman Valve bioassay results appear to be consistent with an operation that worked with less uranium for a shorter duration than Simonds Saw and Steel and Y-12.

NIOSH determined the number of Chapman Valve personnel who were monitored for both internal and external radiation exposures during the operational period. All but two individuals with urinalysis results had external dose data. Therefore, 46 of the individuals who had dosimeters had no records of uranium urinalysis.

7.1.3 Data Sufficiency Conclusions

Individual film badge results are available to determine doses. The reporting limit for beta and gamma was 50 mR. The TBD provides claimant-favorable assumptions that can be used to estimate external doses for those Chapman Valve claims. Some job titles are included with the external dose records; however, job titles do not require specific consideration for most dose reconstructions. The uranium bioassay data have been compared with similar but larger operations and, as discussed in Section 7.1.2.2, the data is comparable. A review of bioassay results at both sites shows the following: the maximum result at Chapman was 0.08 mg/L. Only 5 of the 645 results at Simonds exceeded 0.08 mg/L. The maximum result after June, 1948, at Chapman did not exceed 0.04 mg/L. The Chapman Valve bioassay results are consistent with an operation that worked with less uranium (than Simonds Saw and Steel or Y-12) for a shorter duration.

- <u>External dosimetry data</u>: Film badges were assigned to 81 individuals and 1365 external dosimetry results for Chapman Valve were reported for the weeks beginning May 3, 1948, through November 1, 1948. This period is believed to have been the duration of major uranium operations for the site. Records indicate that personnel who entered the AEC-work area were required to wear dosimeters. Documentation indicates that brass pin-type and stainless steel snap-on badges were used; these were film badges, although the film type is not specified. The film badges were sent to the University of Rochester for processing. The reporting limit was 50 mR for beta and for gamma radiation. It is not possible to associate results with specific individuals in most cases because of poor copies or censored identifiers, but the data have been reviewed to identify the maximum results for each week. The median beta result for May, 1948, (115 mR) and the reporting limit specified on the Chapman Valve reports for gamma (50mR) were used to estimate the exposure for weeks with no reported film badge results (ORAUT-TKBS-0033).

- Internal dosimetry data: Standard photofluorometric methods were used. Typewritten reports are included in the files, and correspondence regarding the 1948 fire indicates that the AEC maintained the bioassay data. Detection thresholds likely ranged between 5 and 10 ug of uranium per liter of urine (Wilson, 1958). The uranium photofluorometric urinalysis detection threshold at Chapman Valve is assumed to be 10 ug/L. The data appear to be representative of the workers and the work, and are consistent with sites involved in similar activities, such as Y-12 and Simonds Saw and Steel (given the difference in uranium throughput). The urine samples were collected after a fire in mid-1948 as well as during the operations thereafter. Results of four sets of worker bioassay data collected during 1948 were used to develop the Chapman co-worker intakes for dose reconstruction. The data are consistent with analyses of bioassay and air sampling data for similar uranium operations during this period.

NIOSH has investigated the pedigree, credibility, and consistency of the external and internal monitoring data for Chapman Valve. NIOSH has not found any evidence of censoring of data or data manipulation that would cast doubt on the integrity of the data for use in dose reconstruction or in the generation of co-worker dose distributions. It is reasonable to conclude that a credible and reputable source was used to analyze the internal and external monitoring samples/dosimeters. The University of Rochester School of Medicine and Dentistry was under contract with AEC's NYOO to perform sample/dosimeter analysis. The University of Rochester performed the bioassay analysis of the 1948 fire urine samples and the dosimeter analysis for all Chapman Valve film badges (Fox, 1949). No clear evidence identifies the organization that analyzed the remaining bioassay data. Based on the analysis results for other sites during this time period (e.g., Simonds Saw and Steel), the likely analyzing organization was either the AEC Health and Safety Division (predecessor of HASL) or the University of Rochester.

7.2 Internal Radiation Doses at Chapman Valve

For the period January 1, 1948, through April 30, 1949, radioactive materials could have become airborne as a result of activities and practices associated with the machining of uranium, including the 1948 uranium fire. Internal radiation exposure during this operational period was from natural uranium dust produced from the manipulation of oxidized metals during machining and related processes. In addition, internal exposures could have occurred for individuals exposed during the documented fire. For unmonitored workers or unmonitored periods, the TBD analyzes the bioassay results to provide estimates of co-workers' uranium intakes (ORAUT-TKBS-0033). Furthermore, intakes of radioactive material was possible after operations were completed (from May 1, 1949 through December 31, 1949, and from January 1, 1991 through December 31, 1993) because of exposures associated with the remaining residual radioactive material (the period from January 1, 1950, through December 31, 1990, falls outside proposed class). The only source term that existed at Chapman for all periods evaluated in this report was associated with natural uranium. Recycled uranium did not enter process streams until 1952, so no recycled uranium would have been processed at Chapman during the 1948 to 1949 operational period (ORAUT-TKBS-0033).

7.2.1 Process-related Internal Doses at Chapman Valve

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

7.2.1.1 Urinalysis Information and Available Data

Individual uranium urinalysis data are available for some Chapman Valve workers. Urinalysis results less than 0.01 mg/L were reported as zero. As indicated in the uranium results (author unknown; Urine, 1948), "…the uranium content of those samples listed as containing less than 0.01 mg U/l is below the limit for reliable determination by the photofluorometric method" and were, therefore, reported as zero. The urinalyses results in this record range from <0.01 to 0.08 mg/L.

Forty Chapman bioassay results were available for samples collected on June 11, July 26-27, September 8-9, and October 7, 1948, from 7, 22, 6, and 5 workers, respectively. The median and 84th percentiles were estimated for each set. The daily uranium excretion in urine was calculated by multiplying the results in mg/L by the specific activity of natural uranium (682.96 pCi/mg) and by reference man's daily urine output (1.4 L/day) (ICRP 23). Table 7-1 shows the bioassay results used in the intake analyses. The Table 7-2 bioassay values were used to estimate median and 84th percentile inhalation intake regimes based on an acute exposure in June, 1948, and a chronic exposure from January 1, 1948, to April 30, 1949. When intakes are estimated from bioassay data, the mode of intake is usually assumed to be inhalation unless there is information indicating that other intake modes are more likely. When using bioassay data, the inhalation intake model assumes that some of the intake behaves as ingested material. In general, intake results from bioassay will be larger when an inhalation rather than an ingestion intake is assumed.

Table 7-2: Bioassay Results from Co-worker Data

Bioassay Date	Median Bioassay (pCi/day)	84th Bioassay (pCi/day)
6/11/1948[a]	16.7	54.6
7/27/1948[b]	7.43	11.3
9/8/1948[c]	9.56	9.56
10/7/1948[d]	9.56	9.56

Source: Urine, 1948

Notes:

a. The seven results were log-transformed and fit to a line, from which a geometric mean and GSD were calculated.

b. The 22 results were log-transformed and fit to a line, from which a geometric mean and GSD were calculated.

c. Five of the six results were reported as 0.01 mg/L and one was reported as <0.01 mg/L. The geometric mean and the 84th percentile were assumed to be 0.01 mg/L.

d. Two of the five results were reported as 0.01 mg/L and three were reported as <0.01 mg/L. The geometric mean and the 84th percentile were assumed to be 0.01 mg/L.

There were uranium intakes resulting from a fire in June, 1948 (Fox, 1949). Although the date of the fire is unknown, it was assumed to have occurred as early as June 1, 1948. The co-worker data fit the assumed intake regimes better when it was assumed that the intake from the fire and the clean-up occurred closer to the date of the bioassay. The bioassay data support both the chronic and acute intake regimes for all the scenarios used to fit the data only when the acute intake from the fire is assumed to occur during the period June 7 to June 10, 1948, inclusive. The assumption that the intake from the fire occurred on June 10, 1948, resulted in the largest total intake. The intake resulting from the fire and clean-up might have occurred over several days, but it was assumed to be an acute intake when fitting the data in order to simplify assumptions.

The combinations of uranium machining and fire intakes were calculated with IMBA Expert™ OCAS-Edition, Version 3.2.20, assuming an absolute uniform error of one and a normal error distribution. To calculate the level of chronic intake for workers who might not have been exposed to the fire, the June 11, 1948, bioassay results were excluded. The geometric standard deviations were calculated by dividing the intake from the 84th regime by the intake from median regime. Table 7-3 shows the inhalation intakes from the analyses of the Chapman uranium urinalysis data.

Table 7-3: Inhalation Intakes Based on Co-worker Data

Scenario[a]	Absorption Type	Chronic Intake 1/1/1948 to 4/30/1949 (pCi/calendar day)	Acute Intake[a] (pCi) 6/10/1948	Total Intake during AEC work (pCi)	Geometric Standard Deviations (intake)
Uranium machining and fire	M	1.50 E+2	3.69 E+2	7.29 E+4	1.14
Uranium machining and fire	S	4.45 E+3	1.28 E+4	2.17 E+6	1.13
Uranium machining	M	1.50 E+2	-	7.29 E+4	1.14
Uranium machining	S	4.48 E+3	-	2.17 E+6	1.14

Source: ORAUT-TKBS-0033
Note a: The acute intakes are associated with geometric standard deviations of about five.

To estimate the total uncertainty in organ dose, the geometric standard deviation for each intake regime in Table 7-3 is combined with the assumed geometric standard deviation of three for the metabolic model (as presented in Section 7.2.1.2).

Intake Assumptions

Human and animal studies have indicated that oxides of uranium can be very insoluble (ICRP, 1995), indicating absorption type S (0.1% and 99.9% with clearance half-times on the order of 10 minutes and 7000 days, respectively). Other *in vitro* dissolution studies of compounds found at uranium facilities have shown that oxides of uranium exhibit moderate solubility (ORAUT-TKBS-0033), suggesting absorption type M (10% and 90% with clearance half-times on the order of 10 minutes and 140 days, respectively). *In vitro* dissolution tests on oxides produced from uranium metal during depleted uranium armor penetrating tests have indicated multi-component dissolution rates, with 25% of uranium dissolving with a half-time of less than or equal to 0.14 days and 75% dissolving with a half-time of 180 days. Because there was no specific information on the solubility of aerosols produced during Chapman operations, this analysis assumed that both types M and S were available. The selection of absorption type for a dose reconstruction is based on the organ of interest and selected to ensure claimant-favorability. For dose calculations, uranium intakes are assumed to be U-234.

The assumed operational exposure period ran from January 1, 1948, to April 30, 1949, which this evaluation assumes to be the natural uranium intake period. A uranium fire is assumed to have occurred sometime between June 1 and June 11, 1948. When analyzing individual bioassay data, the intake from the fire can be assumed to be acute and to have occurred on June 1, 1948, if no other information is available.

7.2.1.2 Unmonitored Workers – Application of Co-Worker Data for Internal Dose Reconstruction

The uranium urinalysis data from Chapman Valve were compared with data from a similar period (November 1-15, 1948) at Simonds Saw and Steel. The Simonds site was used for comparison because of its larger volume of uranium work, abundance of monitoring data, and the similarity of its source term and operations in 1948. The reported air concentrations associated with Simonds' uranium operations appear to be much higher than the few air concentrations measured at Chapman. Simonds' bioassay data for 1948 ranges from 0.00 ug/L to 0.09 ug/L for 67 samples, with only two samples greater than 80 ug/L. Based on this comparison, the bioassay results from Chapman Valve appear to be of a similar magnitude and distribution. The co-worker data set developed for Chapman Valve, using Chapman Valve and similar site data, is presented in Table 7-4.

For unmonitored workers or unmonitored periods, Table 7-4 lists inhalation intake assumptions for natural uranium. Chronic intakes are given in units of pCi/d and acute intakes are given in pCi. Four different intake scenarios are listed. The first two scenarios account for exposure to the uranium fire in June. The last two scenarios can be used when an individual had no exposure to the fire, or to supplement intakes for workers whose bioassays are only associated with the fire. The dose distribution is assumed to be lognormal. Geometric standard deviations are listed in the table.

Table 7-4: Inhalation Intake Summary for Operational Period

Scenarios[a]	Start	End	Intake Type	Absorption Type	Intake (pCi/day or pCi)	Geometric Standard Deviation
Fire plus workplace exposure	1/1/1948 6/10/1948	4/30/1949	Chronic Acute	M M	1.50 E+2 3.69 E+2	3.02 3.02
Fire plus workplace exposure	1/4/1948 6/10/1948	4/30/1949	Chronic Acute	S S	4.45 E+3 1.29 E+4	3.02 3.02
Workplace exposure	1/4/1948	4/30/1949	Chronic	M	1.50 E+2	3.02
Workplace exposure	1/4/1948	4/30/1949	Chronic	S	4.48 E+3	3.02

Source: ORAUT-TKBS-0033

Note a: Only one of the four scenarios from the table is to be used to calculate an organ dose. A worker can qualify for only one of the scenarios.

7.2.2 Ambient Environmental and Residual Radioactivity Internal Radiation Doses

Further evaluation regarding the ambient environmental internal radiation doses for the period from January 1, 1948, through April 30, 1949, is not necessary because these doses are accounted for in the process-related internal dose evaluation.

In the residual radioactivity years, data from a survey report in August, 1992 (ORNL/RASA-92/1), under the Formerly Utilized Sites Remedial Action Program (FUSRAP) were used to calculate intakes. The radiation levels reported at various facility locations are summarized in ORAUT-TKBS-0033. Table 7-5 summarizes the annual internal exposures due to residual radiation for the period of May 1, 1949, to December 31, 1993.

Table 7-5: Annual Internal Exposure to Residual Radioactivity

Internal	Start	End	Exposure	Absorption Type	Intake (pCi/d)	IREP Distribution
Uranium	05-01-49	12-31-93	Inhalation	M, S	8.58E-01	Lognormal GSD 3
	05-01-49	12-31-93	Ingestion	(a)	1.79E-02	Lognormal GSD 3

Note (a): Choose same f_1 value as used for inhalation per OCAS-PR-004.

7.2.3 Internal Dose Reconstruction Feasibility Conclusion

Because both the Chapman bioassay data and the process knowledge of site support activities are limited, the Chapman Valve TBD (ORAUT-TKBS-0033) also considered information from sites with similar operations. Process information and levels of radioactivity encountered during this uranium-metal work are available for these similar sites. The Chapman Valve bioassay data, combined with contract information and uranium metal-handling process knowledge at other sites, are sufficient to either: (1) estimate the maximum internal radiation dose for every type of cancer for which radiation doses are reconstructed that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the internal radiation doses to members of the class more precisely than a maximum dose estimate.

7.3 External Radiation Doses at Chapman Valve

The principal source of external radiation doses for members of the proposed class was natural uranium and its short-lived progeny in the form of metal rods. In 1948, Chapman Valve began machining uranium rods for Brookhaven National Laboratory and continued through April 30, 1949. This analysis assumes that the residual radioactivity period extended from May 1, 1949, through December 31, 1993.

7.3.1 Process-related External Radiation Doses at Chapman Valve

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

7.3.1.1 Individual Dosimetry Data

For the weeks beginning May 3, 1948, through November 1, 1948, Chapman Valve film badge results are available for 81 individuals. When available, individual dosimetry data for the operational period will be used to estimate the external radiation doses for members of the class more precisely than a maximum dose estimate. In the absence of individual data for members of the class, the co-worker approach in Section 7.3.1.2 will be used.

Exposures reported for the weeks beginning October 11, 18, and 25 are questionable because the values on the data sheet appear to indicate that no results were reported, but a notation indicates that results were all less than 50 mR. This apparent discrepancy may be due to the practice of expediting data entry by marking multiple results that were "less than" with an X. The discrepancy was accounted for by using the median of the maximum reported beta result for May (115 mR) and the reporting limit specified on the Chapman Valve reports for gamma (50mR) (which was maximizing for most weeks of exposure) to account for exposure during the weeks of no reported dose above the reporting threshold of 50 mR (ORAUT-TKBS-0033).

7.3.1.2 Unmonitored Workers – Application of Co-Worker Data for External Dose Reconstruction

The analysis of the May to November, 1948, external monitoring data for the operational period is discussed in detail in the Chapman TBD (ORAUT-TKBS-0033). The median beta result for May (115 mR) and the reporting limit specified on the Chapman Valve reports for gamma (50mR) were used to estimate the exposure for other weeks when no film badge results were reported. Exposures during unmonitored weeks were likely to be lower because the majority of processing occurred between May and November, 1948; therefore, these estimates provide a bounding exposure scenario for the period from January to April, 1948, and from December, 1948, to April, 1949. The results of this analysis are presented in Table 7-6.

Table 7-6: External Exposure Summary for Operational Period

Exposure Category	Exposure Type	Exposure or Dose Rate	Basis	Year	Annual Exposure	IREP Distribution
Overestimate of External Dose	Penetrating	4/30/1949	Maximum film badge results	1948 1949	2.830 R 0.850 R	Constant
	Non-penetrating	4/30/1949	Chronic Acute	1948 1949	9.110 R 1.955 R	Constant

Source: ORAUT-TKBS-0033

7.3.2 Ambient Environmental and Residual Radioactivity External Radiation Doses

Further evaluation regarding the ambient environmental external radiation doses for the period from January 1, 1948, through April 30, 1949, is not necessary because these doses are accounted for in the process related external dose evaluation.

The estimated annual external exposures to residual radioactivity from AEC operations at Chapman Valve, listed in Table 7-7, were calculated by assuming that workers were exposed for 2,000 hours per year. In the residual radioactivity years, data from a survey report in August, 1992 (ORNL/RASA-92/1), under the Formerly Utilized Sites Remedial Action Program (FUSRAP), were used to calculate intakes. To estimate the penetrating dose, it was assumed that the largest average result, 13 uR/hr, was the median; and the largest result, 32 uR/hr, was at the 95th percentile. An associated GSD of 1.72 was calculated. The annual penetrating dose estimate is listed in Table 7-7.

In the 1992 survey, a pancake Geiger-Mueller (GM) probe measured count rates and these rates were converted to mrad/h of beta/gamma. The MDA was reported as 0.01 mrad/hr. Such a probe is also sensitive to alpha radiation, which might have resulted in an over-response if a cover or distance from a surface being measured was not maintained to eliminate the alpha response. ORNL (ORNL/RASA-92/1, Figure 7) reported a range of dose rates for each grid block surveyed. The maximum dose rates in the range were used to determine a geometric mean, which was assumed to equal a median non-penetrating dose rate, 0.12 mrad/h. The GSD was calculated to be 2.9. The annual non-penetrating dose is listed in Table 7-7.

The radiation levels reported at various facility locations are summarized in ORAUT-TKBS-0033. Table 7-7 summarizes the annual internal exposures due to residual radioactivity for the period of May 1, 1949, to December 31, 1993.

Table 7-7: Annual External Exposure to Residual Radioactivity

Start	End	Exposure	Basis	R/y	IREP Distribution
05-01-49	12-31-49	Penetrating	Survey Instrument	1.73E-2	Lognormal GSD 1.72
01-01-50	12-31-93	Penetrating	Survey Instrument	2.60E-2	Lognormal GSD 1.72
05-01-49	12-31-49	Non-penetrating	Survey Instrument	1.57E-1	Lognormal GSD 2.9
01-01-50	12-31-93	Non-penetrating	Survey Instrument	2.36E-1	Lognormal GSD 2.9

7.3.3 Chapman Valve Occupational X-Ray Examinations

Information regarding whether or not occupationally required medical X-ray examinations were performed at Chapman Valve is unavailable. The AEC usually, but not always, required “pre-employment” and periodic medical examinations of workers involved in the larger uranium processing programs. The term “pre-employment,” as used here, means prior to performing AEC-contracted radiological work. The typical AEC medical program included a preliminary and annual chest X-ray examination. This analysis assumes that workers received a pre-employment X-ray examination of the chest in 1947 and a second X-ray examination a year later. The method of X-ray examination should be based on current ORAU Team guidance for 1948 exposures. Organ doses can be obtained from the current revision of ORAUT-OTIB-0006, *Technical Information Bulletin: Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures*.

7.3.4 External Dose Reconstruction Feasibility Conclusion

Adequate film badge results are available to estimate doses for Energy Employees who worked in the controlled area for the 1948 to 1949 period. The TBD provides an upper estimate of external dose based on film badge dosimetry records for unmonitored workers or unmonitored periods (ORAUT-TKBS-0033). Based on the reviews and analyses of the available data and the TBD approach, the conclusion is that the Chapman Valve external monitoring data are sufficient to either: (1) estimate the maximum external radiation dose for every type of cancer for which radiation doses are reconstructed that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the external radiation doses to members of the class more precisely than a maximum dose estimate.

7.4 Evaluation of Petition Basis for SEC-00043

The following section evaluates the assertions made on behalf of petition SEC-00043 for the Chapman Valve Manufacturing Company.

7.4.1 Evaluation of Specific Petitioner Statements in SEC-00043

The following specific statements were made by workers on behalf of petition SEC-00043. The italicized statements are from the petition; the comments that follow are from NIOSH.

7.4.1.1 Available Uranium Bioassay Data

SEC-00043: *Bioassay data results (e.g., uranium in urine) are only available for three sets of dates during the Atomic Energy Commission's contract period (January 1948 through April 1949):*

- *July 26-27, 1948, for a total of 22 workers (all but one were collected on the 27th)*
- *September 8-9, 1948, for a total of six workers*
- *October 7, 1948, for a total of five workers*

NIOSH analyzed four sets of samples in the development of the Chapman TBD dose reconstruction method. These samples included the three sets mentioned above as well as the set of bioassay samples taken after the fire (assumed to have occurred in early June, 1948, as addressed in the Chapman Valve TBD). The data are considered representative of the potential exposures from the uranium operations being performed by Chapman Valve because the bioassay samples were collected from employees accessing the restricted Chapman AEC areas in job categories that are considered representative of the workers involved in the AEC project. The bioassay data are consistent with the available Chapman air sample data, and with information from uranium operations at other sites. Bounding exposure scenarios were established in the Chapman Valve TBD through the application of overestimating assumptions, including: (1) the assumption of continuous chronic exposure over the entire operational period even though the majority of uranium machining appears to have been performed between May and November, 1948; and (2) the evaluation of internal exposures using the most claimant-favorable absorption type in the determination of organ dose.

7.4.1.2 Uranium Bioassay Data Detection Limits

SEC-00043: *Most of the bioassay results are at or below the limit of detection at that time (0.01 mg/l). NIOSH concedes in their April 22, 2005, memo to William Powers, Office of U.S. Representative Richard Neal, that they have no documentation about why these samples were collected.*

During the development of the Chapman Valve TBD (ORAU-TKBS-0033), NIOSH analyzed 40 urinalyses in the four sets of data discussed in Section 7.4.1.1 above. Urinalysis results ranged from <0.01 to 0.08 mg/L. Of these results, 55% (22 of the 40) are at or above the detection threshold of 0.01 mg U/L. For those samples with values <0.01 mg U/L, knowledge of the detection threshold for the uranium analysis method that was applied permits the establishment of an upper bound of activity for any sample result that was below that detection threshold which can then be applied in the reconstruction of dose in a claimant-favorable manner. This is because when an individual receives an internal exposure to uranium, the uranium will be excreted from the body in the urine for long periods after the exposure, generally in smaller concentrations over time as the amount of uranium in the body decreases (based on the clearance rate from the body). Each exposure that results in an intake contributes to the total amount of uranium in urine, so the amount of uranium in urine represents a long-term integration of all exposures that occurred prior to collection of the sample.

Collection of bioassay samples by the Atomic Energy Commission (AEC) was a typical practice used to assess exposure conditions at sites. For a program of Chapman's type (uranium metal handling), the available bioassay data, combined with a review of data from other sites, indicate that there is sufficient information to define uranium internal exposures. Although the exact selection criteria are unknown, it was standard for AEC to want to know what the worst-case exposures were so they could determine where additional controls might be most needed. Urine samples were collected from selected workers and analyzed for uranium. The NIOSH assumption applied in the development of the Chapman Valve TBD was that the July-through-October samples were routine bioassay samples. If these samples were incident-related, this assumption would result in intake estimates for the period that would be skewed higher because these would be the high samples; therefore, the chronic exposure assumption results in a more claimant-favorable approach.

7.4.1.3 Estimation of an Upper Bound Dose

SEC-00043: *There is insufficient bioassay data with which to estimate a plausible upper bound dose estimate for internal radiation exposures at Chapman Valve. Production process information is too limited to characterize exposures. Thus, the data that does exist is not representative of the potential exposures. There is only one day of air monitoring data. Thus, it is not feasible to estimate dose with sufficient accuracy.*

NIOSH's research during the development of the Chapman Valve TBD (ORAU-TKBS-0033) concluded that individual monitoring records do exist for Chapman Valve. The frequency of bioassay sampling for the uranium work was consistent with the application of bioassay sampling for the period evaluated, and it can be related to the application of then-current bioassay sampling programs at many sites. Based on the research performed, enough is known about the Chapman Valve production process to estimate exposures with sufficient accuracy for the proposed class.

Air monitoring data are used in this radiological dose reconstruction program to estimate exposures when bioassay data are not available because bioassay data are better representations of worker exposures. Because Chapman Valve bioassay monitoring data are available, the air monitoring data were not used to reconstruct Chapman worker doses, as discussed in the Chapman Valve TBD.

As previously discussed, the assumed operational exposure period ran from January 1, 1948, to April 30, 1949. Although the information available on the operations at Chapman Valve indicate that the majority of machining and uranium-handling operations only occurred from May 1948, through November 1948, the Chapman Valve TBD analysis assumes the entire operational period to be the uranium intake period. In addition, two intake scenarios are provided for monitored and unmonitored workers. The first scenario accounts for exposure to the uranium fire in June 1948. The second scenario can be used when an individual had no exposure to the fire, or to supplement intake determinations for workers whose bioassays are only associated with the fire. The data derived from this approach are similar to data from other sites performing similar operations during the same period. (NOTE: Y-12 was one of the larger sites involved in uranium-handling work during this time period and operations at that site included machining and lathing of uranium. A comparison of Chapman intakes with the Y-12 co-worker internal data analysis shows that the geometric means for Chapman's type M intake rate is 63% of Y-12's and Chapman's type S intake rate is 140% of Y-12's; the bioassay results also appear to be of similar magnitudes).

7.4.1.4 Estimation of Uranium Exposures from a Site Fire

SEC-00043: *Although seven workers were monitored after a documented uranium fire in May or June of 1948, the date of the fire is unknown. The monitoring was performed in early June. Because the dates of exposure(s) are unknown, the actual uranium uptakes are unknown.*

Chapman Valve(Fox, 1949) notes that: "A fire occurred in the restricted area of the AEC project and on June 11th [1948] urine for analyses … was sent to the School of Medicine and Dentistry of Rochester New York." The collection of urine samples from the workers who put out the fire, and from clean-up personnel, suggests that uranium was involved in the fire. NIOSH discovered no documentation that identified the exact date of the fire, although AEC (Wolf, 1949) noted in the transmittal of the urinalysis results that the samples had been "collected from the seven employees involved in the fire fighting episode last June [1948]." However, the actual Chapman Valve bioassay data were evaluated in bioassay models during the development of the Chapman Valve TBD dose reconstruction methodology to evaluate intake scenarios for deriving the best estimate of an intake date/period with final values that err in favor of the claimant. NIOSH based the final internal dose reconstruction method applied in the Chapman Valve TBD on their review of the data from this evaluation.

7.4.1.5 Estimation of Enriched Uranium Exposures

SEC-00043: *The Site Profile indicates that only natural uranium (0.7% U235) was used at Chapman Valve. It appears that, in addition to machining natural uranium, low enriched uranium was present. Oak Ridge National Laboratory (ORNL) found 2.16% enriched uranium in a Chapman site soil survey done for an environmental cleanup.*

The Chapman Valve uranium processing was related to reactor needs and the use of enriched uranium in reactors was rare until 1950. Specifically Chapman Valve was contracted to machine uranium for the first Brookhaven National Laboratory test reactor (Brookhaven Graphite Research Reactor [BGRR]), a breeder reactor that first went critical in 1950, and was originally loaded with natural uranium. The only mentions of Chapman Valve and enriched uranium were in a 1997 ORNL survey report (ORNL/RASA-95/17), which reiterated a 1992 ORNL survey report (ORNL/RASA-92/1) that stated that the sample contained "slightly enriched (2.16%) Uranium-235." The 1997 report attributed the small amount to background levels. Based on the review of the Chapman Valve site documentation, including the document that identified the single sample result of 2.16% enriched uranium (ORNL/RASA-92/1), NIOSH did not identify any other data to indicate that the uranium processed at Chapman Valve during the covered period was enriched, noting that, in 1948, enriched uranium was not typically sent to non-government-controlled sites without extra precautions. The conclusions of this review, and basis of the decision to apply natural uranium in the calculations, are included in the Chapman Valve TBD. However, this issue of uranium enrichment as is relates to dose evaluation at Chapman Valve does not have any bearing on the feasibility of dose reconstruction. It relates only to deciding on particular values to be used in dose calculations.

7.4.1.6 Consideration of Other Industrial Processes

SEC-00043: *The Site Profile does not assess exposures from a number of industrial processes, such as the cracking furnace or the uranium chip incinerator, and does not evaluate the potential for a uranium-rolling operation or the presence of low enriched uranium. The Site Profile indicated that:*

- *the Chapman Valve . . . facility had a "cracking furnace."*
- *high uranium stack readings were measured on the roof. The purpose of the furnace was unknown to NIOSH and its use in the production operation is unknown to surviving workers.*
- *a NIOSH/ORAU staffer was provided with a map prepared by ORNL showing the location of a chip burner.*
- *air sample results from May 4 are measurements of the effluent from the furnace outlet on the roof and are not appropriate for determining workers' doses.*

The AEC operations performed by Chapman Valve did not involve any material or chemical separation/conversion process. Therefore, any exposure issues associated with the work would have been due to only mechanical processing of the uranium. The uranium enrichment issues have been addressed in Section 7.4.1.5.

The Chapman Valve TBD addresses individual exposures for all Chapman Valve operations. Based on the information provided in the Chapman Valve Final Remedial Action Report (Chapman, 1996), and during the Chapman Valve meetings, it is assumed that there was a furnace at Chapman Valve (also referred to as the chip incinerator, chip burner, and cracking furnace). On the map provided at the February 14, 2005, meeting, a chip burner is shown on the west side of Building 23 in an area consistent with the AEC restricted area. At what appears to be a similar location, ORNL/RASA-92/1 reported elevated contamination near a window. Robbins reported contamination was found in the area "where a chip burner was located in the southwest corner of Grid A-1 that exhausted to the atmosphere out a nearby window. The exhaust location and the shape of the roof of the building would lead to the deposition of more contamination on the south roof than the north roof as indicated by characterization measurements." (Robbins, 1996) Because bioassay samples were collected from individuals working in the restricted area, the exposures from the incinerator would be reflected in the co-worker data. It seems most likely that the Heat Treater Foreman and some of the Helpers would have been involved with furnace work.

The Chapman Valve TBD does address and evaluate the air sampling performed in the exhaust stack of the furnace. NUMEC 1966 and 1967 data regarding air concentrations and bioassays related to incinerator operations, referred to as "primitive" by NUMEC, were provided by attendees at the February 14, 2005, meeting. Although NUMEC appears to have handled primarily enriched uranium, and NUMEC 1960s operations might have been quite different than in 1948 at Chapman, comparisons can be made. The average breathing zone concentration at different NUMEC locations ranged from 848 to 6666 pCi/m3 (these could be a factor of 2 to 100 lower when normalized for the difference in specific activity between the NUMEC and Chapman Valve uranium enrichments); these compare with calculated 95th percentile exposures of 139 to 4129 pCi/m3 from Chapman Valve co-worker bioassay results. The bioassay data for workers in the incinerator area at NUMEC were also available in the provided report and these, too, were considered. The reported NUMEC bioassay results ranged from 37 to 68 ug/L assuming normal uranium, which would be 16 to 29 ug/L for 2% enriched uranium, and 0.24 to 0.45 ug/L for 93.5% enriched uranium.

Although NIOSH has not discovered information (either through document searches or worker interviews) that provides definitive information regarding the exact purpose of the furnace in 1948, it seems likely that it would have been used to oxidize ("roast") uranium sweepings and turnings so they were converted to a more non-pyrophoric form that would be safer to store and ship. As previously stated, air monitoring data are used to estimate exposures when bioassay data are <u>not</u> available because bioassay data are better representations of worker exposures. Because Chapman Valve bioassay monitoring data are available, the air monitoring data were not used to reconstruct Chapman worker doses, as discussed in the Chapman Valve TBD.

NIOSH has not identified evidence that AEC-contracted uranium-rolling operations were performed at Chapman Valve. A New York Operations Office (NYOO) Monthly Status and Progress Report indicates that Chapman was contracted by BNL to machine uranium for the BNL test reactor pile. The rods that Chapman machined came from Hanford (NYOO, 11-14-47). Note: The first BNL test reactor (Brookhaven Graphite Research Reactor [BGRR]) was a breeder reactor, originally loaded with natural uranium. A separate NYOO report does not include Chapman in the sites listed as performing uranium-rolling operations (NYOO, 11-12-48). Even if uranium-rolling operations were performed at Chapman Valve, the intakes still would have been accounted for by the bioassay data.

7.4.1.7 Available Air Sampling Data

SEC-00043: *There is only one day of uranium air samples. Data was taken on 05/24/48. Data showed elevated levels of uranium, which raises questions about overall levels of uranium dust/smoke in the facility and the absence of contamination controls.*

It is true that workers were exposed to uranium dust at this facility and others. As discussed in this report, NIOSH has bioassay data from the workers which enable NIOSH to estimate the doses associated with these worker exposures and provide more accurate estimates of dose than would air monitoring data. The air monitoring data were not used to reconstruct Chapman worker doses, as discussed in the Chapman Valve TBD.

7.4.1.8 Uranium Fires

SEC-00043: *NIOSH does not assume any frequency for uranium fires in the site profile, even though documentation at other facilities shows that uranium fires are prevalent in uranium milling/lathing operations due to the fact that uranium is a pyrophoric material.*

The June fire that occurred at Chapman was accounted for in the TBD through the use of individual bioassay results. These results are incident related and can be identified with the workers involved with the fire and cleanup. As previously discussed, samples were typically collected from workers thought to have the greatest likelihood of exposure. The NIOSH assumption applied in the development of the Chapman Valve TBD was that the July-through-October samples were routine bioassay samples. If these samples were incident-related, this assumption would result in intake estimates for the period that would be skewed higher because these would be the high samples; therefore, the NIOSH approach results in the most claimant favorable dose.

7.5 Summary of Feasibility Findings for Petition SEC-00043

This report evaluated the feasibility for completing dose reconstructions for employees at the Chapman Valve Manufacturing Company from January 1, 1948, through December 31, 1949, and from January 1, 1991, through December 31, 1993. It was determined that the available monitoring records, process descriptions, and source term data are sufficient to either: (1) estimate the maximum internal radiation dose for every type of cancer for which radiation doses are reconstructed that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the internal radiation doses to members of the class more precisely than a maximum dose estimate. NIOSH did identify employees at the facility during this time period for which complete dose reconstruction would be feasible.

It is important to note that the Chapman Valve TBD is currently being revised to reflect current NIOSH practices. In addition, the TBD will be revised to provide further clarification to issues identified by the petitioner, as appropriate. However, the technical changes being made to the TBD do not affect the conclusions in this evaluation report.

Table 7-8 summarizes the results of the feasibility findings at Chapman Valve for each exposure source for the time period January 1, 1948, through December 31, 1949, and from January 1, 1991, through December 31, 1993.

Table 7-8: Summary of Feasibility Findings for SEC-00043

Source of Exposure	Maximum Exposure Can Be Determined	Maximum Exposure Cannot Be Determined
Internal	X	
- Urinalysis (*in vitro*)	X	
External	X	
- Gamma	X	
- Beta	X	
- Occupational Medical x-ray	X	

8.0 Evaluation of Health Endangerment for Petition SEC-00043

The health endangerment determination for the class of employees covered by this evaluation report is governed by EEOICPA and 42 CFR § 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. This evaluation, however, determined that it is feasible to estimate with sufficient accuracy the radiation doses for members of this class. Therefore, a determination of health endangerment is not required.

9.0 NIOSH Proposed Class for Petition SEC-00043

Based on its research, NIOSH modified the petitioner-requested class to define a single class of employees for which NIOSH can estimate radiation doses with sufficient accuracy. The NIOSH-proposed class includes: all AWE employees who were monitored, or should have been monitored, for radiological exposures while performing Atomic Energy Commission work in Building 23 at Chapman Valve Manufacturing Company in Indian Orchard, Massachusetts, from January 1, 1948, through December 31, 1949, and from January 1, 1991, through December 31, 1993.

For the purposes of this evaluation, the period from January 1, 1948, through April 30, 1949 is evaluated as the operational period; the periods from May 1, 1949, through December 31, 1949, and from January 1, 1991, through December 31, 1993, are evaluated as residual radioactivity periods. The latter time period of the petitioner-requested class was reduced from 1991 through 1995 to 1991 through 1993 in order to expedite the evaluation of this SEC Petition. The period 1994 through 1995 period will be evaluated as a Remediation Period. The remediation work was performed by Bechtel National, Inc. (BNI). Based on preliminary investigations of the remediation period, BNI had a fully-implemented radiation protection program in place during the remediation work. The development of a dose reconstruction method for this period in the Chapman Valve Technical Basis Document has been reserved pending further research. NIOSH is continuing to evaluate the 1994-1995 remediation period, and available data, for Chapman Valve and will address this period in an addendum to this Evaluation Report.

These considerations are based on existing, approved NIOSH processes used in dose reconstruction for claims under EEOICPA. The 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 dose 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 that it would be feasible to reconstruct the dose for the class represented in this petition.

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10.0 References

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42 CFR 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 CFR 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 USC §§ 7384-7385 [EEOICPA], *Energy Employees Occupational Illness Compensation Program Act of 2000*; as amended

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AEC, 05-06-48, *AEC-NYDO Sample Record #_*, Radiological Laboratory; New York, New York; May 6, 1948; SRDB Ref ID: 16436

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