SEC Petition Evaluation Report
Petition SEC-00131

Report Rev #: 0 Report Submittal Date: June 30, 2009

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Petition Administrative Summary

Petition Under Evaluation

Petition #	Petition Type	Petition Qualification Date	DOE/AWE Facility Name
SEC-00131	83.13	January 26, 2009	Bliss & Laughlin Steel Company

Petitioner Class Definition

All employees of Bliss & Laughlin Steel Company for the period from 1948 through 1998.

Class Evaluated by NIOSH

All employees of Bliss & Laughlin Steel Company located at 110 Hopkins Street, Buffalo, New York, for the period from January 1, 1951 through December 31, 1952 and/or during the residual period from January 1, 1953 through December 31, 1998.

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

None

Related Petition Summary Information

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

Related Evaluation Report Information

Report Title	DOE/AWE Facility Name
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Evaluation Report Summary: SEC-00131, Bliss & Laughlin Steel Co.

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

Petitioner-Requested Class Definition

Petition SEC-00131, qualified on January 26, 2009, requested that NIOSH consider the following class: *All employees of Bliss & Laughlin Steel Company, for the period from January 1, 1948 through December 31, 1998.*

Class Evaluated by NIOSH

Based on its preliminary research, NIOSH accepted the petitioner-requested class and revised the operational start date based on the covered period determined by the Department of Labor. The covered period start date changed from 1948 to 1951. Therefore, NIOSH evaluated the following class: All employees of Bliss & Laughlin Steel Company located at 110 Hopkins Street, Buffalo, New York, for the period from January 1, 1951 through December 31, 1952 and/or during the residual period from January 1, 1953 through December 31, 1998.

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

Based on its full research of the class under evaluation, NIOSH has obtained process information and air monitoring data collected during the Bliss rod-turning operations, and has assessed Battelle-TBD-6000, Battelle-TBD-6001, and monitoring data bounding similar operations at other sites. Based on its analysis of these available resources, NIOSH found no part of the class under evaluation for which it cannot estimate radiation doses with sufficient accuracy.

Feasibility of Dose Reconstruction

Per EEOICPA and 42 C.F.R. § 83.13(c)(1), NIOSH has established that it has access to sufficient information to: (1) estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred in plausible circumstances by any member of the class; or (2) estimate radiation doses of members of the class more precisely than an estimate of maximum dose. Information available from the site profile and additional resources is sufficient to document or estimate the maximum internal and external potential exposure to members of the evaluated class under plausible circumstances during the specified period.

Health Endangerment Determination

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

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ATTRIBUTION AND ANNOTATION: This is a single-author document. All conclusions drawn from the data presented in this evaluation were made by the ORAU Team Lead Technical Evaluator: Donald R. Watkins, Oak Ridge Associated Universities. These conclusions were peer-reviewed by the individuals listed on the cover page. The rationales for all conclusions in this document are explained in the associated text.

1.0 Purpose and Scope

This report evaluates the feasibility of reconstructing doses for all employees of Bliss & Laughlin Steel Company for the period from January 1, 1951 through December 31, 1952 and/or during the residual period from January 1, 1953 through December 31, 1998. It provides information and analyses germane to considering a petition for adding a class of employees to the congressionally-created SEC.

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

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

2.0 Introduction

Both EEOICPA and 42 C.F.R. pt. 83 require NIOSH to evaluate qualified petitions requesting that the Department of Health and Human Services (HHS) add a class of employees to the SEC. The evaluation is intended to provide a fair, science-based determination of whether it is feasible to estimate with sufficient accuracy the radiation doses of the class of employees through NIOSH dose reconstructions.[1]

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

Under 42 C.F.R. § 83.13(c)(3), if it is not feasible to estimate with sufficient accuracy radiation doses for members of the class, then NIOSH must determine that there is a reasonable likelihood that such

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

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 occurring during nuclear criticality incidents. If the occurrence of such an exceptionally high-level exposure has not been established, then NIOSH is required to specify that health was endangered for those workers who were employed for at least 250 aggregated work days within the parameters established for the class or in combination with work days within the parameters established for other SEC classes (excluding aggregate work day requirements).

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

3.0 SEC-00131 Bliss & Laughlin Steel Co. Class Definitions

The following subsections address the evolution of the class definition for SEC-00131, Bliss & Laughlin Steel Company. When a petition is submitted, the requested class definition is reviewed as submitted. Based on its review of the available site information and data, NIOSH will make a determination whether to qualify for full evaluation all, some, or no part of the petitioner-proposed class. If some portion of the petitioner-proposed class is qualified, NIOSH will specify that class along with a justification for any modification of petitioner's class. After a full evaluation of the qualified class, NIOSH will determine whether to propose a class for addition to the SEC and will specify that proposed class definition.

3.1 Petitioner-Requested Class Definition and Basis

Petition SEC-00131, qualified on January 26, 2009, requested that NIOSH consider the following class for addition to the SEC*: All employees of Bliss & Laughlin Steel Company, for the period from 1948 through 1998.*

The petitioner provided information and affidavit statements in support of the petitioner's belief that accurate dose reconstruction over time is impossible for the Bliss & Laughlin Steel Company workers in question. NIOSH deemed the following information and affidavit statements sufficient to qualify SEC-00131 for evaluation:

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

> The petitioner indicated that there are no monitoring records available at NIOSH to the best of their knowledge. The petitioner referred to documents and research materials that indicate radiation exposures occurred and but were not monitored. (OSA Ref ID: 107118)

Based on its Bliss & Laughlin Steel Company research and data capture efforts, NIOSH determined that it has access to air sample data and process information for the Bliss & Laughlin work during the time period under evaluation. However, NIOSH also determined that no air sample data were available for the first rod-machining done in April 1951; therefore, records are not complete for all time periods. NIOSH concluded that there is sufficient documentation to support, for at least part of the proposed time period, the petition basis that internal and external radiation exposures and radiation doses were not adequately monitored at the Bliss & Laughlin site, either through personal monitoring or area monitoring. The information and statements provided by the petitioner qualified the petition for further consideration by NIOSH, the Board, and HHS. The details of the petition basis are addressed in Section 7.4.

3.2 Class Evaluated by NIOSH

Based on its preliminary research, NIOSH accepted the petitioner-requested class and revised the operational start date based on the covered period determined by the Department of Labor. The covered period start date changed from 1948 to 1951. Therefore, NIOSH defined the following class for further evaluation: All employees of Bliss & Laughlin Steel Company located at 110 Hopkins Street, Buffalo, New York, for the period from January 1, 1951 through December 31, 1952 and/or during the residual period from January 1, 1953 through December 31, 1998.

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

Based on its research, NIOSH has obtained process information and air monitoring data collected during the Bliss rod-turning operations, and has assessed Battelle-TBD-6000 and monitoring data bounding similar operations at other sites. Based on its analysis of these available resources, NIOSH found no part of the class under evaluation for which it cannot estimate radiation doses with sufficient accuracy.

4.0 Data Sources Reviewed by NIOSH to Evaluate the Class

As a standard practice, NIOSH completed an extensive database and Internet search for information regarding Bliss & Laughlin Steel Company. The database search included the DOE Legacy Management Considered Sites database, the DOE Office of Scientific and Technical Information (OSTI) database, the Energy Citations database, the Atomic Energy Technical Report database, and the Hanford Declassified Document Retrieval System. In addition to general Internet searches, the NIOSH Internet search included OSTI OpenNet Advanced searches, OSTI Information Bridge Fielded searches, Nuclear Regulatory Commission (NRC) Agency-wide Documents Access and Management (ADAMS) web searches, the DOE Office of Human Radiation Experiments website, and the DOE-National Nuclear Security Administration-Nevada Site Office-search.

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

4.1 Site Profile Technical Basis Documents (TBDs)

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

- *Site Profiles for Atomic Weapons Employers that Worked Uranium and Thorium Metals*, Battelle TBD-6000 PNWD-3738; Rev. FO; December 13, 2006; SRDB Ref ID: 30671

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

4.2 Technical Information Bulletins (TIBs)

A Technical Information Bulletin (TIB) is a general working document that provides guidance for preparing dose reconstructions at particular sites or categories of sites. NIOSH reviewed the following TIBs as part of its evaluation:

- *Dose Reconstruction from Occupationally Related Diagnostic X-ray Procedures*, ORAUT-OTIB-0006, Rev 03 PC-1; Oak Ridge Associated Universities; December 21, 2005; SRDB Ref ID: 20220

- *Dose Reconstruction During Residual Radioactivity Periods at Atomic Weapons Employer Facilities*, ORAUT-OTIB-0070, Rev 00; Oak Ridge Associated Universities; March 10, 2008; SRDB Ref ID: 41603

4.3 Facility Employees and Experts

To obtain additional information, NIOSH attempted to interview four former Bliss & Laughlin employees, one Niagara LaSalle Steel Co. employee (now operating the former Bliss site), and one former National Lead of Ohio (NLO) employee. The individuals that worked at Niagara LaSalle Steel Co. and NLO, and the individual designated as a Bliss & Laughlin Chemist, were unable to provide any information because these individuals were not employed at NLO or Bliss & Laughlin during the class period under evaluation. The petitioner provided one individual's name in the petition, but that

individual is now deceased. A review of Bliss & Laughlin claimants showed that most are deceased or not employed during the period when the uranium machining took place. Several attempts were made to contact an identified retired Bliss & Laughlin Machine Operator. No contact was accomplished and no response was received.

- Personal Communication, 2009a, *Personal Communication with Former Bliss & Laughlin Chemist*; Telephone Interview by ORAU Team; March 5, 2009; SRDB Ref ID: 63717

- Personal Communication, 2009b, *Personal Communication with Former National Lead of Ohio Employee*; Telephone Interview by ORAU Team; March 6, 2009; SRDB Ref ID: 63719

- Personal Communication, 2009c, *Personal Communication with Niagara LaSalle Steel Co. Employee*; Telephone Interview by ORAU Team; March 9, 2009; SRDB Ref ID: 63718

- Personal Communication, 2009d, *Personal Communication with Former Bliss & Laughlin Clerk*; Telephone Interview by ORAU Team; March 24, 2009; SRDB Ref ID: 63712

- Personal Communication, 2009e, *Personal Communication with Former Bliss & Laughlin Janitor*; Telephone Interview by ORAU Team; March 25, 2009; SRDB Ref ID: 63713

4.4 Previous Dose Reconstructions

NIOSH reviewed its NIOSH OCAS Claims Tracking System (NOCTS) to locate EEOICPA-related dose reconstructions that might provide information relevant to the petition evaluation. Table 4-1 summarizes the results of this review. (NOCTS data available as of June 23, 2009.)

Table 4-1: No. of Bliss & Laughlin Steel Claims Submitted Under the Dose Reconstruction Rule

Description	Totals
Total number of claims submitted for dose reconstruction	23
Total number of claims submitted for energy employees who meet the definition criteria for the class under evaluation January 1, 1951 through December 31, 1952 and/or January 1, 1953 through December 31, 1998 (residual period).	21
Number of dose reconstructions completed for energy employees who meet the definition criteria for the class under evaluation (i.e., the number of such claims completed by NIOSH and submitted to the Department of Labor for final approval).	21
Number of claims for which internal dosimetry records were obtained for the identified years in the evaluated class definition	0
Number of claims for which external dosimetry records were obtained for the identified years in the evaluated class definition	0

NIOSH reviewed each claim to determine whether internal and/or external personal monitoring records could be obtained for the employee. All dose reconstructions performed to date were completed without any internal or external dosimetry data. External doses were estimated based on external exposure pathways determined from site operations, source term information, and claimant-favorable assumptions and parameters described in Battelle-TBD-6000. Internal dose was estimated based on airborne radioactivity data compiled from similar operations at other uranium metal processing facilities (Battelle-TBD-6000 and ORAUT-OTIB-0004). Actual air sample data are available for this facility and are found to be within the bounding estimates of the data from Battelle-TBD-6000 (discussed further in Section 7.3).

4.5 NIOSH Site Research Database

NIOSH also examined its Site Research Database (SRDB) to locate documents supporting the evaluation of the proposed class. Approximately 200 documents in this database were identified as pertaining to the Bliss & Laughlin Steel Company site. These documents were evaluated for their relevance to this petition. The documents include historical background on site operations, air sampling data, progress reports listing types of work done at the facility with dates and quantities, and a facility description.

4.6 Other Technical Sources

A number of papers in technical journals that dealt with machining of uranium metal were also reviewed:

- *The Industrial Hygiene of Uranium Fabrication*, W. B. Harris and I. Kingsley; American Medical Association Archives of Industrial Health, May 1959, Vol. 19, pp. 540-565; SRDB Ref ID: 15779 (Harris, 1959)

- *The Industrial Hygiene of Uranium Fabrication*, W. B. Harris (AEC Health and Safety Laboratory) and I. Kingsley (New York State Department of Labor); U.S. Atomic Energy Commission, New York Operations Office; HASL-39; June 6, 1958; SRDB Ref ID: 15785 (HASL-39)

4.7 Documentation and/or Affidavits Provided by Petitioners

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

- Excerpts from *Radiological Survey of the Former Bliss and Laughlin Steel Company Facility, Buffalo, New York*, J. D. Berger; June 1992; OSA Ref ID: 107118, pdf pp. 30-35

- Memo: *Authorization for Remedial Action at Bliss & Laughlin Steel Company Site in Buffalo, New York,* from J. W. Wagoner to L. Price; September 25, 1992; OSA Ref ID: 107118, pdf pp. 25-29

- Excerpt: *Radiological Survey of the Exterior Portions of the Former Bliss and Laughlin Steel Company Facility Buffalo, New York,* T. J. Vitkus; January 1995; OSA Ref ID: 107118, pdf p. 15

- Portions of other documents contained in the *Formerly Utilized Sites Remedial Action Program, Administrative Record File for Bliss & Laughlin FUSRAP Site, Buffalo, New York;* OSA Ref ID: 107118, pdf p. 24

- *Portion of a Narrative from [REDACTED FOR PRIVACY ACT CONCERNS], date unknown;* OSA Ref ID: 107118, pdf p. 38

- Finding of Fact excerpted from the *Notice of Recommended Decision Statement of the Case,* from DOL to Claimants; September 9, 2005; OSA Ref ID: 107118, pdf p. 39

5.0 Radiological Operations Relevant to the Class Evaluated by NIOSH

The following subsections summarize both radiological operations at the Bliss & Laughlin Steel Company during the applicable covered period at the site and the information available to NIOSH to characterize particular processes and radioactive source materials. From available sources NIOSH has gathered process and source descriptions, information regarding the identity and quantities of each radionuclide of concern, and information describing processes through which radiation exposures may have occurred and the physical environment in which they may have occurred. The information included within this evaluation report is intended only to be a summary of the available information.

5.1 Bliss & Laughlin Steel Co. Plant and Process Descriptions

The former Bliss & Laughlin Steel Company site is a 306,000 square foot tract located at 110 Hopkins Street in Lackawanna, New York, a suburb approximately four miles southeast of downtown Buffalo (FUSRAP, 1998a). Bliss & Laughlin operated the site from 1929 to 1971, producing cold-finished steel bars for heavy equipment such as automobiles, appliances, construction machinery, and farm equipment. The plant was closed by a strike in 1971 and was sold the following year. After a number of ownership changes, the plant is currently owned by the Niagara LaSalle Corporation. Bliss & Laughlin Steel was part of what was referred to as "The Buffalo Works," portions of which were operated by Bliss & Laughlin, Bethlehem Steel, and American Car and Foundry. The operations performed by the "Buffalo Works" were transferred to the AEC-owned South Albuquerque Works in 1952 (Buffalo, 2001; Bliss, 2001).

The facility consists of a single slab-on-grade building with a floor area of approximately 129,600 square feet. Site operations under evaluation in this report involved normal assay uranium metal owned by the AEC. Operations at Bliss & Laughlin consisted of machine-turning and straightening of rods to improve the rod diameter tolerance. The uranium metal-finishing operations were conducted at a location within the building designated as the Special Finishing Area that occupies approximately 3,230 square feet of floor space. The floor in that area was characterized as rough surface concrete with several shallow utility trenches providing water, electricity, lubricant, and pneumatic plant services.

Available records indicate that Bliss & Laughlin performed five normal assay uranium rod-machining campaigns for the AEC: one in April 1951 and four in September and October 1952. During September and October 1952, Bliss & Laughlin was under contract to National Lead of Ohio (NLO) to machine and straighten uranium rods at the site. NLO was the AEC's prime contractor for all operations at the Feed Materials Production Center at Fernald, Ohio, northwest of Cincinnati. Specific contractual arrangements for the work performed in 1951 are not known, although the work was clearly done under the auspices of AEC's Tonawanda Area Office. The low-level radioactive contamination at the site is confined primarily to the floor space and three overhead rafters. The primary radiological constituent of concern is uranium and its radioactive decay products.

An April 24, 1951 AEC New York Operations Office (NYOO) internal memo outlined plans for a "uranium fabrication test" (i.e., preliminary trials of the uranium rod-machining work to be conducted at Bliss & Laughlin). The preliminary work was to involve the transport of about two tons of normal assay uranium rods that had already been rough-rolled at Simonds Saw and Steel and temporarily stored at AEC's nearby Lake Ontario Ordinance Works (LOOW) site. On April 24th or 25th, at least twenty 1-5/8" diameter rough-rolled rods were to be machined to a slightly smaller diameter using an unventilated lathe employing aqueous coolant. Following the machining, the finished rods and turnings were to be picked by an AEC carrier and trucked back to the LOOW, and subsequently to Bethlehem Steel for further rolling (NYOO, 1951; Tonawanda, Apr1951). An October 1951 letter from AEC's Tonawanda Operations Office indicates that these planned preliminary uranium fabrication operations did take place at Bliss & Laughlin in spring 1951, and that the limited work activities resulted in at least four drums of dry uranium oxide that the AEC shipped to the Mallinckrodt Chemical Works in St. Louis, probably in November or December 1951 (Oxide, 1951; Stout, 1990a).

The more substantial uranium rod-machining operations performed in September and October 1952 were conducted on one Friday and three Saturdays. Weekend schedules were used to avoid significantly impacting normal operations, and possibly, to enhance security and radiological safety. Records indicate that AEC staff arranged for the transportation of all raw materials, wastes, and products to and from the site, and that Bliss & Laughlin personnel were not involved in these aspects of the operations. Documentation further states that all radiologically-contaminated equipment was removed and replaced at the close of uranium-machining operations. (Williams, 1992; Stout, 1990b; Fiore, 1992; FUSRAP, 1998a)

Although no contract documents have been located, it is known that the 1952 AEC work was performed under a subcontract issued by National Lead of Ohio, operator of the AEC's Feed Materials Production Center (FMPC) at Fernald, Ohio. NYOO records show that rough-rolled rods were shipped to Bliss & Laughlin from the LOOW site. After the machining work was completed, the finished products were shipped directly to the FMPC. Available records indicate that 53 drums of uranium turnings resulting from these operations were accumulated at LOOW for packaging under oil, and were then returned to the FMPC sometime in November 1952 (Tonawanda, Nov1952).

No information has been located that specifies the total amount of product produced by the 1952 operations; but, due to the relatively short duration of the operations, total quantities can be assumed to have been somewhat limited. (Berger, 1992b) However, if it is assumed that all 53 drums of the residual waste material were metal-turning chips, and that all 53 drums were of standard 55-gallon size and were all mostly full, then a significant number of rods may have been fabricated during these

operations (Stout, 1990a). A few documents provide some idea of the material volume and the process:

- An AEC Tonawanda Area Office progress report states that, in late August or early September 1952, ten truckloads of rolled uranium "rod in beams" were unloaded at LOOW by NLO workers. NLO personnel sorted these rods to determine which ones might already be acceptable for machining at the FMPC; "unacceptable" rods were to be taken to Bliss & Laughlin for "finishing to final size." (Tonawanda, Aug1952)

- A Tonawanda Area Office progress report dated October 1952 indicates that, during that month, 31 beams of uranium rods were loaded at the LOOW and shipped to Bliss & Laughlin "for machining and consignment to NLO." This document also reports that "all uranium turnings resulting from the Bliss & Laughlin operations have been returned via AEC truck to LOOW for packaging under oil and re-consignment from LOOW to Fernald." (Tonawanda, Oct1952a)

- A Tonawanda Area Office progress report for November 1952 reports that "Fifty-three drums of uranium turnings which National Lead Company had accumulated at LOOW from Bliss & Laughlin machining operations were delivered to Fernald by LOOW truck and personnel." (Tonawanda, Nov1952)

A review of an AEC Tonawanda Office progress report dated October 24, 1952, for the period October 20-24 (Tonawanda, Oct1952a) contains the following statement: "15 drums of turnings were picked up by LOOW truck at Bliss & Laughlin Co., Buffalo NY and returned to LOOW for storage under oil. This material was the result of a machining operation at Bliss on October 18. The rods produced were shipped directly to Fernald Area." This is the only report where this machining date is mentioned. A review of the Fernald documents has no mention of this machining nor are there any monitoring data to support it. Furthermore, an NLO letter dated October 11, 1952 (Letter, 1952) states: "As far as I know, this was the last rod turning operation at Bliss & Laughlin." Thus, it is unclear what the October 24 Tonawanda report is referring to.

5.2 Radiological Exposure Sources from Bliss & Laughlin Steel Co. Operations

The following subsections provide an overview of the internal and external exposure sources for the Bliss & Laughlin Steel Company class under evaluation.

5.2.1 Internal Radiological Exposure Sources from Bliss & Laughlin Operations

The Bliss & Laughlin Steel Company are known to have performed five uranium rod-turning campaigns for the AEC: one in April 1951 and four in September and October 1952. During September and October 1952, Bliss & Laughlin was under contract to National Lead of Ohio to machine and straighten uranium rods. The primary radiological constituent of concern is uranium and its radioactive decay products.

5.2.1.1 Uranium

The principal source of internal radiation doses for members of the class under evaluation was inhalation and ingestion of uranium particles in the dust generated by the machining and direct handling of uranium metal.

According to reports prepared by AEC's Tonawanda Area Office, on or about April 24th, 1951, approximately two tons of uranium metal, comprised of at least twenty 1-5/8" diameter rods, were delivered to Bliss & Laughlin from the LOOW and machined to a slightly smaller diameter using an unventilated lathe that employed an aqueous coolant. After the turning operations were complete, the machined rods were returned to LOOW. In October 1951, arrangements were made for four drums of dry uranium oxide (presumably residual material from the April 1951 machining operations) to be shipped to Mallinckrodt Chemical Works. (FUSRAP, 1998a; Oxide, 1951; Stout, 1990a)

Available information shows that a considerably more substantial uranium rod-machining effort was conducted on at least four weekends in October and November, 1952. AEC reports indicate that the product rods resulting from these machinings were shipped directly from Bliss & Laughlin to the FMPC. Fifty-three drums of machine turnings were returned to LOOW to be repackaged under oil for safe transport back to the FMPC. (FUSRAP, 1998a)

5.2.2 External Radiological Exposure Sources from Bliss & Laughlin Operations

External radiological exposures from AEC operations at Bliss & Laughlin Steel resulted from uranium machining operations and drumming of uranium residues.

5.2.2.1 Photon

The external photon radiation exposure source was the natural uranium metals that were handled during the 1951 and 1952 rod-turning operations and the residue handled as a result of these operations. Solid uranium objects provide considerable shielding of the lower-energy photons from uranium metals and harden the spectrum, causing the majority of photons emitted from a solid uranium object, such as a billet or rod, to have higher energies. While it is recognized that solid uranium sources will have a hardened photon spectrum, exposure to a thin layer of uranium on a surface will result in a larger fraction of exposure to lower-energy photons.

5.2.2.2 Beta

The external beta radiation exposure source was from the uranium rod-turning operations in 1951 and 1952. The dominant beta radiation source was from the surface of the uranium rods. In the U-238 decay scheme, there is a short-lived isotope, protactinium-234m. This isotope decays by emitting an energetic 2.28 MeV beta particle. It is this beta particle that accounts for the shallow-dose hazard associated with handling the uranium metal.

5.2.2.3 Neutron

Neutron doses from exposure to natural uranium, including uranium metals, are considered negligible (Battelle-TBD-6000, Section 3.4).

5.2.3 Residual Radioactivity Period at Bliss & Laughlin Steel Company Site

The residual radioactivity period for the Bliss & Laughlin Steel Company site starts after operations were completed. The residual period ends with the 1998-99 FUSRAP remediation of the site (Buffalo, 2007). Remediation characterization radiological surveys were performed by Oak Ridge Associated Universities health physicists in March 1992. It was determined that fixed residual radiological contamination remaining in the former work areas nominally exceeded the U.S. Government's guidelines for the release of contaminated property for unrestricted use. These guidelines are delineated in DOE Order 5400.5, Chapter IV. Accordingly, on September 25, 1992, the Bliss & Laughlin site was designated as a property eligible for environmental remediation under the U.S. Department of Energy's Formerly Utilized Sites Remedial Action Program (FUSRAP) (Authorization, 1992). Note: Jurisdiction for the FUSRAP program was transferred from DOE to the U. S. Army Corps of Engineers in 1997.

Residual uranium contamination was confined primarily to the floor space in the former Special Finishing Area and three overhead ceiling rafters, where static dust and residues contained U-238 at a concentration of approximately 30 pCi/g. Surface activity measurements in the Special Finishing Area revealed several locations with total beta levels ranging from 4,700 dpm/100cm^2 to 700,000 dpm/100cm^2. Removable alpha activity at these locations ranged from less than 12 dpm/100cm^2 to 426 dpm/100cm^2; removable beta activity ranged from less than 15 dpm/100cm^2 to 544 dpm/100cm^2. Activity levels at other locations in the Special Finishing Area were less than detection limits (i.e., 880 dpm/100cm^2 total beta, 12 dpm/100cm^2 removable alpha, and 15 dpm/100cm^2 removable beta). Based on spot surveys of the remaining portions of the building, including locker rooms, other high-traffic areas, and adjacent outdoor areas, there did not appear to be any additional significant contamination of the plant facility or its surrounding environment. Soil samples taken at locations around the outside of the building showed no soil contamination. (Berger, 1992a; FUSRAP, 1998a; Berger, 1992c)

Under the regulatory framework of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a Remedial Investigation/Feasibility Study (RI/FS) and Proposed Plan (PP) for remediation were released for public comment on September 28, 1998. A CERCLA Record of Decision (ROD) for remediation was signed on December 11, 1998. (FUSRAP, 1998c)

Remediation of the Bliss & Laughlin site began in late 1998 and continued through March 1999. Ceiling trusses were remediated by scraping, wiping, and high-efficiency vacuum. Scabbling (a process that grinds and removes the surface of concrete) and jackhammers were used to remove surface contamination on the floor and from the concrete over a former utility trench west of the Special Finishing Area. Contaminated metal shavings and other debris were manually removed from a second trench and from a former pit area. The concrete pad previously poured to cover one of the two trenches in the Special Finishing Area was scabbled, jackhammered, and sand-blasted. Approximately 60 cubic yards of contaminated debris generated during the decontamination operations were shipped to a licensed commercial disposal facility in Clive, Utah. Residual

contamination levels were surveyed and certified as being below the applicable facility release criteria under 10 CFR 20, Subpart E. No post-remediation monitoring, maintenance, or site inspections were deemed necessary for this site (Buffalo, 2007).

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

The following subsections provide an overview of the state of the available internal and external monitoring data for the Bliss & Laughlin class under evaluation.

6.1 Available Bliss & Laughlin Steel Co. Internal Monitoring Data

NIOSH reviewed AEC historical records and found no evidence of personnel internal bioassay monitoring at the Bliss & Laughlin site. Radiological air monitoring was conducted by NLO personnel during the uranium rod-machining performed on September 26, September 27, October 4, and October 11, 1952 (Data Sheets, 1952). With the largest equipment item running (a Medart rod-turning machine), total alpha air concentrations measured in the general work area were considerably above the worker exposure control level guideline in effect at that time. These measurements nominally ranged from about 60 dpm/m^3 to about 4,900 dpm/m^3 above the guideline of 70 dpm/m^3.

Air samples were taken in the immediate vicinity of the operating Medart machine in order to estimate the source term. The samples were designated as "P" (Process) on the air sample sheets. The P sample results were extremely high, approximately 57,000 dpm/m^3 on average with a maximum reading of 216,000 dpm/m^3. However, samples obtained in the general work area shortly after all of the equipment was turned off showed only slightly elevated levels of radioactivity (Fiore, 1992; Data Sheets, 1952). The method NIOSH employed to estimate a bounding internal dose based on these data is discussed in Section 7.2.

6.2 Available Bliss & Laughlin Steel Co. External Monitoring Data

To date, NIOSH has been unable to find any records regarding external monitoring data for Bliss & Laughlin Steel Company employees. Therefore, personnel external dose estimates will be based on available air monitoring and source term data. The method NIOSH employed to estimate a bounding external dose is discussed in Section 7.3.

7.0 Feasibility of Dose Reconstruction for the Class Evaluated by NIOSH

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

In determining feasibility, NIOSH begins by evaluating whether current or completed NIOSH dose reconstructions demonstrate the feasibility of estimating with sufficient accuracy the potential radiation exposures of the class. If the conclusion is one of infeasibility, NIOSH systematically evaluates the sufficiency of different types of monitoring data, process and source or source term data, which together or individually might assure that NIOSH can estimate either the maximum doses that members of the class might have incurred, or more precise quantities that reflect the variability of exposures experienced by groups or individual members of the class as summarized in Section 7.5. This approach is discussed in OCAS's SEC Petition Evaluation Internal Procedures which are available at http://www.cdc.gov/niosh/ocas. The next four major subsections of this Evaluation Report examine:

- The sufficiency and reliability of the available data. (Section 7.1)
- The feasibility of reconstructing internal radiation doses. (Section 7.2)
- The feasibility of reconstructing external radiation doses. (Section 7.3)
- The bases for petition SEC-00131 as submitted by the petitioner. (Section 7.4)

7.1 Pedigree of Bliss & Laughlin Steel Company Data

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

7.1.1 Internal Monitoring Data Pedigree Review

Although there is information related to the operational and radiological air monitoring performed at Bliss & Laughlin (associated with the NLO monitoring progam), NIOSH has been unable to find any bioassay data or any indication that any additional bioassay monitoring was performed during the Bliss & Laughlin operations. Based on NIOSH's review of similar sites, the selection of the monitoring types and monitoring approaches were consistently applied across the programs that NLO evaluated during that era (NLO, 1952). The monitoring data that are available are air sample data. The Bliss & Laughlin uranium metal-working operations were conducted over weekend shifts to avoid disruption of normal plant operations. As an investigative activity, monitoring was performed to assess the conditions surrounding the operations. "Air dust" monitoring was performed and NIOSH has copies of primary source results from this air monitoring for four different test operations: September 26, September 27, October 4, and October 11, 1952. (Data Sheets, 1952). These results included General Area samples, Process samples (used to determine sources of air contamination or the relative contribution of two or more sources) and Breathing Zone samples. While process samples are not necessarily representative of an employee's routine exposure, they are useful in supporting the quantification of an upper bound of potential airborne contamination exposure because they do represent an absolute worst-case exposure scenario during the site's uranium-machining operations (Air Sampling, 1973).

The air sample data for the Bliss & Laughlin operations have been compared to the Battelle-TBD-6000 internal dose evaluation methods. These methods include air sampling data collected from other AWE facilities that machined uranium and are considered representative measurements for most of the processes that took place at metal-working AWE sites. The air sample data are categorized in Battelle-TBD-6000 based on common uranium metal-working processes. The evaluation of that comparison is contained in the sections that follow.

Air monitoring and surface contamination monitoring data from the residual period are available. NIOSH reviewed these data and determined that they meet NIOSH's standards for performing individual dose reconstruction during the residual period, and that they are sufficient for determining an upper-bound estimate of residual contamination levels. The residual period FUSRAP radiological surveys are documented in primary documents, including the FUSRAP Radiological Sample Log Book (FUSRAP, 1995), direct surface contamination survey reports, a 1992 independent radiological survey (Berger, 1992b), and a 1995 radiological assessment (Vitkus, 1995).

7.1.2 External Monitoring Data Pedigree Review

NIOSH reviewed the data available for the Bliss & Laughlin site and determined that no external dosimetry data are available for the AWE operations conducted in 1951 and 1952; therefore, no data pedigree review was possible. External dose rates from uranium metal-working operations at other AWE sites have been studied and documented (Battelle-TBD-6000, p. 39) and, when coupled with conservative estimates of how much material may have been on site, provide a means of estimating external dose from direct contact with uranium metal.

As discussed in Section 7.1.1, surface contamination monitoring data from the residual period are available. Soil sample data are also available as a result of characterization efforts at the site. The contamination and soil sample data are sufficient for determining an upper-bound estimate of residual contamination levels. The residual period FUSRAP radiological surveys are documented in primary documents, including the FUSRAP Radiological Sample Log Book (FUSRAP, 1995), direct surface contamination survey reports, the 1992 independent radiological survey (Berger, 1992b) and a 1995 radiological assessment (Vitkus, 1995). External dose is further described in Section 7.3.

7.2 Evaluation of Bounding Internal Radiation Doses at Bliss & Laughlin

The principal source of internal radiation doses for members of the class under evaluation was from the inhalation and ingestion of uranium particles in the dust generated by the machining and handling of uranium metal. The following subsections address the ability to bound internal doses, methods for bounding doses, and the feasibility of internal dose reconstruction.

7.2.1 Evaluation of Bounding Process-Related Internal Doses

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

NIOSH reviewed historical records and found no evidence of personnel internal monitoring at the Bliss & Laughlin site. Therefore, personnel internal dose estimates will be based on air monitoring and source term data. Battelle-TBD-6000 will be used as the basis for reasonably bounding internal exposures the class under evaluation. An assessment of this methodology is included in Section 7.2.3 of this report.

7.2.1.1 Airborne Levels

Air sample data are available for four of the five uranium rod-machining operations performed at Bliss & Laughlin. NIOSH has been unable to find any monitoring data for the first rod-machining that took place around April 24, 1951 (FUSRAP, 1998a; Tonawanda, Apr1951). The data for the first three rod-turnings in 1952 can be used to bound the exposure for this turning because there was no change in the operational method between 1951 and 1952 and the amount of uranium machined was significantly greater based on the resulting drums of residue (only four drums were generated in 1951; the remainder of the 53 total drums of residue were generated in 1952) (FUSRAP, 1998a; Oxide, 1951; Tonawanda, Oct1952b; Tonawanda, Nov1952). The air sample data from the last rod-turning operation (October 11) are being excluded because the use of fans potentially changed the exposure conditions (Letter, 1952); therefore, the data are not supportive of a bounding internal exposure assessment for the class under evaluation.

The air samples collected include general area samples (GA), breathing zone samples (BZ) and air samples associated with various processes (P) (Data Sheets, 1952). This information is corroborated in NLO weekly reports dated September 26, October 3, October 9, October 16, October 17, and October 21, 1952 (Weekly Report, 1952a; Weekly Reports, 1952-54; Weekly Report, 1952b; Monthly Reports, 1952).

As previously discussed at the end of Section 5.1, the Tonawanda Weekly Progress Report dated October 24 (for the week of October 20-24) mentions picking up 15 drums of turnings for operations conducted October 18, 1952 (Tonawanda, Oct1952a); this operation is not supported by any other documentation. If any additional uranium rod-machining took place on October 18, the air sample data collected during the first three machinings on September 26, September 27, and October 4, 1952, can be used to bound the intake resulting from the October 18 machining.

7.2.1.2 Alternative Data Sources for Bounding Internal Dose

The current method available for internal dose reconstruction is in Battelle-TBD-6000. The representative air sample data from uranium metal-working facilities provided in Battelle-TBD-6000 are based on work done by Harris & Kingsley (Harris, 1959; HASL-39). Based on NIOSH's review and comparisons, the air sample data from Battelle-TBD-6000 used to evaluate the internal dose bounds the potential Bliss & Laughlin personnel dose when compared to the evaluation using actual air sample data collected during Bliss & Laughlin Steel machining operations (Spreadsheet, 2009).

7.2.2 Evaluation of Bounding Residual Period Internal Doses

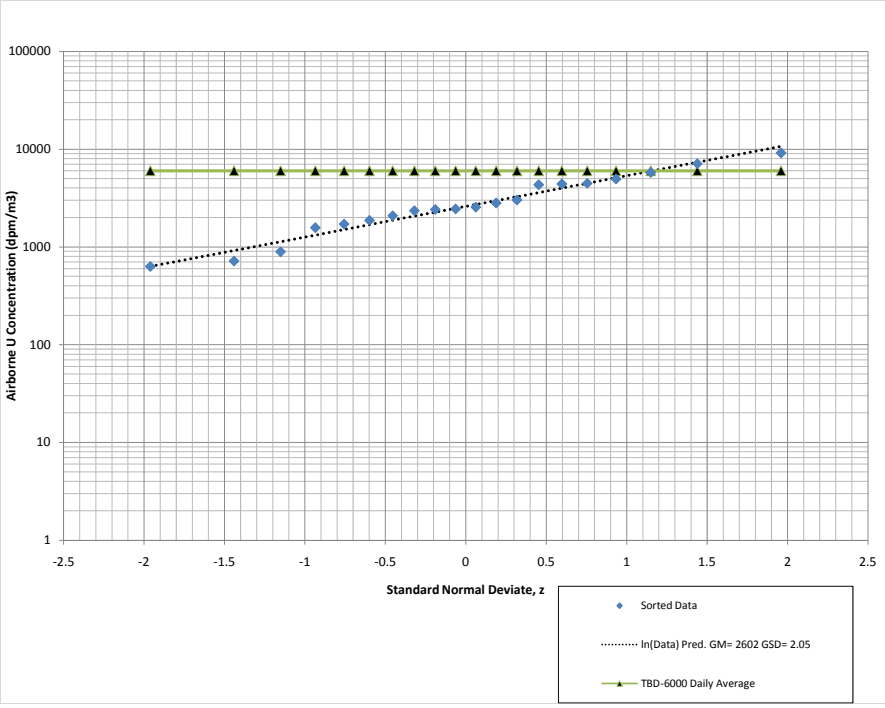
Internal dose from the residual period is the result of residual contamination remaining from the uranium-machining operations. Residual period internal exposure would result from the re-suspension of surface contamination. Dose estimates from inhalation and ingestion or re-suspended contamination were calculated using a re-suspension model described in Battelle-TBD-6000 (Sections 7.1.5 and 7.1.6) and ORAUT-OTIB-0070.

7.2.3 Methods for Bounding Internal Dose at Bliss & Laughlin Steel Company

7.2.3.1 Methods for Bounding Operational Period Internal Dose

Using the available Bliss & Laughlin data, NIOSH evaluated the actual air sample data and compared the results with the values in the analysis contained in Battelle-TBD-6000. The airborne concentration estimates from Battelle-TBD-6000, Table 7.5, for machining uranium (assuming worst-case conditions associated with the centerless grinder) yield a maximum airborne concentration of 6000 dpm/m^3, with a geometric mean of 5480 dpm/m^3 and a geometric standard deviation (GSD) of 5. The 1952 Bliss & Laughlin breathing zone and general area air sample data yields a maximum airborne concentration of 9131 dpm/m^3, with a geometric mean of 2603 dpm/m^3 and a GSD of 2.06 (Spreadsheet, 2009). The plot of the calculated data is shown in Figure 7-1.

Figure 7-1: Comparison of Estimated Internal Dose (Battelle-TBD-6000 vs. B&L Air Data)



The intake values for the class under evaluation can be calculated from the air sample data through the application of a standard breathing rate, activity conversion factor, and exposure period(s). The methods outlined in Battelle-TBD-6000 provide techniques to evaluate internal dose associated with uranium-machining operations as a result of internal exposures to uranium and its daughter products. The techniques include air sample data that are typically obtained when workers are exposed during uranium-machining operations. As discussed above, the methods and values provided in Battelle-TBD-6000, in light of the evaluation and comparison with the available air sample data for site operations, support NIOSH's ability to bound internal dose for the class under evaluation during the site's operational period.

7.2.3.2 Methods for Bounding Residual Period Internal Dose

Internal dose estimates for the residual period (January 1, 1953 to December 31, 1998) were based on inhalation and ingestion resulting from re-suspension of residual contamination resulting from uranium machining operations. This would include re-suspension from incidental removal of residual contamination (e.g., via housekeeping and personnel and equipment movement). Intakes from the residual period can be bounded using Battelle-TBD-6000 and ORAUT-OTIB-0070. Based on Battelle-TBD-6000, the assumptions for estimating intakes during the residual period are that there was no decontamination, and the operational airborne activity concentration was 100 MAC or 7000 dpm/m^3. In order to determine a surface contamination level, an indoor settling velocity of 7.5 E-4 m/s is applied over a one year operating period. The result is an estimated surface contamination of 3.44 E7 pCi/m^2 (7.64E5 dpm/100 cm^2). This surface contamination value is considered bounding based on the available information from the radiological surveys obtained during the residual period (Berger, 1992a; Berger 1992b; Berger 1992c; FUSRAP, 1995; FUSRAP, 1998a; FUSRAP, 1998b; FUSRAP, 1998c). A re-suspension factor of 1 E-6/m may be applied to the surface contamination level to obtain an estimated airborne concentration of 34.4 pCi/m^3. The daily intake is based on source term data from large-scale operations and is likely to be significantly higher than intakes at Bliss & Laughlin at the start of the residual period. In order to account for the continued depletion of the operational source term during the residual period, a source term depletion factor of 1% of the surface activity per day is applied after the first and subsequent year. Afterwards, the source term is assumed to remain constant. The ingestion during the residual period can also be estimated based on airborne concentration. Exposure will be evaluated on a case-by-case basis for individual claims, but the available data and methods described here supports NIOSH's ability to bound internal dose for the evaluated class during the site's residual period.

Table 7-1 shows the adjustment factors used to account for the depletion of the source term during the residual period.

Table 7-1: Adjustment Factors for Depletion of Source Term During the Residual Period

Year	Factor	Intake (pCi/d)
1953	1	413
1954	0.03	12.4
1955	0.0007	0.3
1956 – 1998	0.0007	0.3

7.2.4 Internal Dose Reconstruction Feasibility Conclusion

This evaluation concludes that internal dose for both the operational and residual period at Bliss & Laughlin Steel can be bounded using the air sample data in Battelle-TBD-6000, which are derived from the Harris and Kingsley publications (HASL-39; Harris, 1959) and methodologies discussed in ORAUT-OTIB-0070.

NIOSH has shown that the actual air sample data for the operational period, which include breathing zone and general area air sample data collected during the Bliss & Laughlin uranium machining, are bounded by the methods and values for uranium machining contained in Battelle-TBD-6000. Based on the assessment provided in this section, NIOSH's conclusion is that Battelle-TBD-6000 provides a reasonable approach to bound internal dose for the operational period for all members of the class under evaluation. NIOSH may choose to employ a more refined approach when reconstructing individual doses based on information obtained during the Bliss & Laughlin petition evaluation. The specific exposure period will be evaluated on a case-by-case basis for individual claims. NIOSH will use appropriate dose reconstruction methods, including best-estimate approaches that employ the details of the site operations, to complete individual dose reconstructions.

Based on the assessment of these data and methodologies, NIOSH concludes that the methods described in Battelle-TBD-6000 and ORAUT-OTIB-0070 also provide reasonable approaches to bound residual period internal dose for all members of the class under evaluation.

7.3 Evaluation of Bounding External Radiation Doses at Bliss & Laughlin

The principal sources of external radiation doses for members of the proposed class were deposition of uranium particles in the dust from the machining of uranium rods and the direct handling of uranium (Battelle-TBD-6000, Section 6.0). The following subsections address the ability to bound external doses, methods for bounding doses, and the feasibility of external dose reconstruction.

7.3.1 Evaluation of Bounding Process-Related External Doses

Section 6.0 of Battelle-TBD-6000, and Section 7.0 of Battelle-TBD-6001, provide bounding occupational external dose estimates for various refining and metal operations for various job titles, including rod-machining and drumming operations. Listed job titles include operators, general labor, supervisors, and clerical. Battelle-TBD-6000 addresses the following modes of external exposure: submersion in a contaminated dust cloud, exposure to contaminated surfaces, and whole body exposure from photon and beta radiation emitted from uranium metal. Battelle-TBD-6001 addresses external exposures resulting from uranium-drumming operations. The TBD assumes typical conditions for the type of workplace addressed, but uses worst-case exposure conditions. As previously discussed, NIOSH's comparison of the calculated internal dose using the available Bliss air monitoring data with the values in the analysis contained in Battelle-TBD-6000 supports a bounding internal dose estimation approach (Data Sheets, 1952; Spreadsheet, 2009). Considering this information and the operations performed at Bliss & Laughlin, NIOSH has applied the external dose Battelle-TBD-6000 and Battelle-TBD-6001 methods for the bounding external dose for the Bliss & Laughlin operational period.

7.3.2 Evaluation of Bounding Residual Period External Doses

Based on the available FUSRAP survey information, the available operational information, and the information in Section 5.1.2 of Battelle-TBD-6000, annual external doses from residual contamination could be assigned and bounded from 1953 until 1998 when the Bliss & Laughlin Steel site was decontaminated and released under the FUSRAP program (Berger, 1992b).

7.3.3 Bliss & Laughlin Steel Company Occupational X-Ray Examinations

In addition to the estimated dose received from uranium-machining operations, the dose received from diagnostic X-ray procedures could also be included in the overall external dose. It is not known if Bliss & Laughlin required chest X-rays for workers. Although no records have been identified that indicate that occupational medical X-rays were required, the dose associated with X-ray exams can be assessed using the methodology defined in ORAUT-OTIB-0006, *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures.* NIOSH believes that this methodology supports it ability to bound the occupational medical X-ray doses for the evaluated class.

7.3.4 Methods for Bounding External Dose at Bliss & Laughlin Steel Company

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

- Photon Dose
- Beta Dose
- Medical X-ray Dose

7.3.4.1 Methods for Bounding Operational Period External Dose

Photon Dose

Although no external monitoring data are available for the Bliss & Laughlin site, Section 6.0 of Battelle-TBD-6000 can be used to bound the operational period photon dose, as discussed in Section 7.3.1. The data in Table 6.4 in Battelle-TBD-6000 applicable to rod-machining operations at metal-working sites corresponding to the Bliss operational period are presented in Table 7-2. Data in this table are chosen for worst-case exposures. The data assume that the facility operates full-time over the course of a year (2000 hrs/yr). For individual worker exposure assessment, these values could be scaled for the fraction of the year actually worked.

Table 7-2: Estimated Daily Doses and External Exposure Pathways for Uranium Machining

Job Title	Years	Air Submersion (mR)	Contaminated Floor Exposure (mR)	Metal Whole-Body Dose (mrem)	Hands & Forearms Non-Penetrating Dose (mrem)	Other Skin Non-Penetrating Dose (mrem)
Operator	1951-52	8.131E-05	8.412E-03	6.27	693	63
General Labor	1951-52	4.066E-05	4.206E-03	1.12	347	31
Supervisor	1951-52	2.033E-05	2.103E-03	0.562	35	3
Clerical	1951-52	2.033E-06	2.103E-04	0.056	0	0

Source: Battelle-TBD-6000
Note: Values represent the geometric mean of a lognormal distribution with geometric standard deviation equal to 5.0.

Section 7.0 of Battelle-TBD-6001 can be used to estimate the dose received from drumming operations during the Bliss & Laughlin operational period. Section 7.3, *Drum Doses*, can be used to estimate the dose rate from drums containing uranium compounds (see Table 7-3). The drum doses were modeled using a 100-day decay time, which allows the ingrowth of uranium progeny and a content density of 1.6. This combination of density and isotopic composition will result in higher-than-normal dose rates. In order to account for Bremsstrahlung, the doses seen in the table were doubled, as the Bremsstrahlung dose is typically the same as the photon dose (Battelle TBD-6001).

Table 7-3: Dose Rates from Drums of Uranium Compounds

Drum Size (gallon)	Dose Rate (mr/h)			
	1 cm	10 cm	30 cm	100cm
5	3.7	1.4	0.4	0.1
30	4.4	2.5	1.1	0.2
55	4.5	2.8	1.3	0.3

Source: Battelle-TBD-6001

Based on information obtained about the Medart Bar Turner, the chips from the turning operation were collected in a chip collector bucket or pit, thereby containing them (Medart, 1992). This process would result in limited handling of residue from the machining operation and minimal dose from drum-handling.

Beta Dose

As previously discussed, although no external monitoring data are available for the Bliss & Laughlin site, Section 6.0 of Battelle-TBD-6000 can be used to reconstruct the beta dose. The section of Table 6.4 in Battelle-TBD-6000 applicable to rod-machining operations at metal-working sites corresponding to the Bliss operational period is reproduced in Table 7-2.

7.3.4.2 Methods for Bounding Residual Period External Doses

The external exposure sources for the residual period included exposure from contaminated surfaces and submersion in re-suspended surface contamination. The methodology used to estimate external doses is based on operational data in Section 5.1.2 of Battelle-TBD-6000. This methodology estimates radiological conditions immediately following operations and does not take into account any reduction of contamination levels due to decontamination and/or depletion.

An optional method for evaluating external dose during the residual radioactivity period is to use the actual airborne levels during operations to establish surface contamination levels at the start of the residual radioactivity period, and then deplete the values over time. This information, coupled with the radiological survey data presented in the FUSRAP surveys, can be used to establish factors for evaluating external dose over the residual radioactivity period.

7.3.5 External Dose Reconstruction Feasibility Conclusion

This evaluation concludes that external dose reconstruction for personnel working during the operations period at the Bliss & Laughlin Steel Company site is feasible. By modeling external dose from Battelle-TBD-6000, Battelle-TBD-6001, and ORAUT-OTIB-0006, dose estimates are plausible and bounding for the operational period at the site. In addition, this evaluation supports the ability to bound residual period doses based on Battelle-TBD-6000. Based on its assessment of these doses, NIOSH concludes that the methods described in Battelle-TBD-6000 provide reasonable approaches to conservatively bound external doses for all members of the class under evaluation. NIOSH may choose to employ a more refined approach when reconstructing individual doses based on information obtained during the evaluation of the Bliss & Laughlin SEC petition. The specific exposure period will be evaluated on a case-by-case basis for individual claims.

7.4 Evaluation of Petition Basis for SEC-00131

The following subsections evaluate the assertions made on behalf of petition SEC-00131 for the Bliss & Laughlin site.

7.4.1 Uranium Rolling and Lack of Monitoring

SEC-00131: *The basis for the petition is that the entire facility was used to roll uranium bars. There is a lack of or no monitoring records to the best of their knowledge, and that radiation exposures were incurred, but were not monitored.*

The uranium was not rolled; it was machined on a Medart Bar Turner within the Bliss & Laughlin facility in a location called the Special Finishing Area. That area is comprised of approximately 3,230 square feet of floor space. There were a total of five rod-machining campaigns performed in April 1951 and September and October of 1952. While it is true that there are no internal or external monitoring data, there are air sample data collected during the 1952 campaigns. Based on the quantity machined in 1952 versus 1951, the air sample data from 1952 can be used to bound the exposure during the 1951 campaign. Using the methodologies and typical air sample data provided for uranium machining in Battelle-TBD-6000 and/or the actual air sample data collected during the uranium machining at Bliss & Laughlin, the external and internal dose can be estimated and/or bounded.

7.5 Summary of Feasibility Findings for Petition SEC-00131

This report evaluates the feasibility for completing dose reconstructions for employees at the Bliss & Laughlin Steel Company facility during the applicable covered period. NIOSH found that the available monitoring records, process descriptions, source term data, and alternative data sources are sufficient to complete dose reconstructions for the evaluated class of employees.

Table 7-4 summarizes the results of the feasibility findings at Bliss & Laughlin Steel Company for each exposure source during the time period January 1, 1951 through December 31, 1952 and/or during the residual period from January 1, 1953 through December 31, 1998.

Table 7-4: Summary of Feasibility Findings for SEC-00131
January 1, 1951 through December 31, 1952 and/or January 1, 1953 through December 31, 1998 (residual period)

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

[1] As discussed, only applicable to the period when radioactive materials were on site (i.e., starting in April 1951 through the end of the residual radioactivity period in 1998).

As of June 23, 2009, a total of 21 claims have been submitted to NIOSH for individuals who worked at Bliss & Laughlin Steel Company and who are covered by the class definition under evaluation. Dose reconstructions have been completed for 21 individuals (100%).

8.0 Evaluation of Health Endangerment for Petition SEC-00131

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

Based on Bliss & Laughlin process information and air monitoring data, the information in Battelle-TBD-6000, Battelle-TBD-6001, and ORAUT-OTIB-0070, and monitoring data bounding similar operations at other sites, NIOSH's evaluation determined that it is feasible to estimate radiation dose for members of the NIOSH-evaluated class with sufficient accuracy based on the sum of information available from available resources. Modification of the class definition regarding health endangerment and minimum required employment periods, therefore, is not required.

9.0 Class Conclusion for Petition SEC-00131

Based on its full research of the class under evaluation, NIOSH found no part of said class for which it cannot estimate radiation doses with sufficient accuracy. This class includes all employees of Bliss & Laughlin Steel Company located at 110 Hopkins Street, Buffalo, New York, for the period from January 1, 1951 through December 31, 1952 and/or during the residual period from January 1, 1953 through December 31, 1998.

NIOSH has carefully reviewed all material sent in by the petitioner, including the specific assertions stated in the petition, and has responded herein (see Section 7.4). NIOSH has also reviewed available technical resources and many other references, including the Site Research Database (SRDB), for information relevant to SEC-00131. In addition, NIOSH reviewed its NOCTS dose reconstruction database to identify EEOICPA-related dose reconstructions that might provide information relevant to the petition evaluation.

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

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Attachment 1: Data Capture Synopsis

Table A1-1: Data Capture Synopsis for Bliss & Laughlin Steel Company

Data Capture Information	Data Captured Description	Date Completed	Uploaded
Primary Site/Company Name: Bliss & Laughlin Steel; AWE 1951-1952; Residual Radiation 1953-1998 Other company names: B & L Steel 1952-1971 Ramco-Fitzsimmons 1972-1985 Niagara Cold Drawn 1986-1992 Niagara LaSalle 1992 -present	Mike Hood of Niagara LaSalle confirmed that no Bliss & Laughlin records from the NLO uranium machining experiment are held at either the Buffalo site or the New York corporate offices of Niagara Corporation.	03/05/2009	0
State Contacted: John Mitchell, New York State Department of Environmental Conservation (NYSDEC)	NYSDEC records and New York State Archives were searched, no relevant documents were found.	03/12/2009	0
Comprehensive Epidemiologic Data Resource (CEDR)	No relevant documents identified.	03/22/2009	0
Department of Labor/Paragon CD	Memo requesting authorization to ship drums of dry uranium oxide from Bliss & Laughlin to Mallinckrodt.	12/30/2008	1
DOE Hanford Declassified Document Retrieval System (DDRS)	No relevant documents identified.	03/22/2009	0
DOE Legacy Management Considered Sites	New York Operations Office monthly report and a DOE Office of Legacy Management fact sheet.	10/26/2007	2
DOE Legacy Management - Grand Junction	FUSRAP documents and surveys, interior and exterior radiological surveys, characterization and hazard categorization, and a Tonawanda Area monthly progress report.	01/30/2009	27
DOE Legacy Management - MoundView (Fernald Holdings, includes Fernald Legal Database)	NLO weekly and monthly reports, a memo with measures to reduce air dust at the rod turning operation, and a LOOW progress report mentioning delivery of stencils to Bliss & Laughlin.	03/06/2009	4
DOE OpenNet	Linking Legacies Appendix B identifies Bliss & Laughlin as a uranium machining operator.	03/22/2009	1
DOE OSTI Energy Citations	No relevant documents identified.	03/22/2009	0
DOE OSTI Information Bridge	No relevant documents identified.	03/22/2009	0
DOE Fernald Records Center, prior to DOE Legacy Management jurisdiction	Air samples from rod turning operation.	06/26/2003	1

Table A1-1: Data Capture Synopsis for Bliss & Laughlin Steel Company			
Data Capture Information	**Data Captured Description**	**Date Completed**	**Uploaded**
Google	Nuclear News Weapons Program remediation and compensation articles, US Army Corps of Engineers closure reports, record of decision and RI/FS news releases, a Brookings Institution report identifying Bliss & Laughlin as an NLO subcontractor, a listing of contaminated Buffalo, NY sites compiled by the city of Buffalo, and a Bechtel status report.	03/20/2009	13
Kansas City Federal Records Center (FRC) (Lenexa)	FUSRAP surveys, sample logs, characterization, radiological dose and safety assessments, and fact sheet.	03/06/2009	12
Oak Ridge Associated Universities (ORAU) Team	Analysis of Bliss & Laughlin air sample data.	03/20/2009	1
National Academies Press (NAP)	No relevant documents identified.	03/22/2009	0
National Nuclear Security Administration (NNSA) - Nevada Site Office	No relevant documents identified.	03/22/2009	0
NRC Agencywide Document Access and Management (ADAMS)	Long term surveillance and maintenance program report and a FUSRAP management requirements and policies manual.	03/22/2009	2
Unknown	FUSRAP documents and surveys, Madison Square Office uranium inventories and New York Operations Office reports.	07/11/2003	12
Washington State University (U.S. Transuranium and Uranium Registries)	No relevant documents identified.	03/22/2009	0
TOTAL			**76**

Table A1-2: Database Searches for Bliss & Laughlin Steel Company			
Database/Source	**Keywords**	**Hits**	**Uploaded**
DOE CEDR http://cedr.lbl.gov/ COMPLETED 03/22/2009	bliss & laughlin	0	0
	"niagara cold drawn"		
	"niagara cold"		
	"cold drawn"		
	"niagara lasalle"		
	"ramco-fitzsimmons"		
	"ramco"		
	"b & l steel"		
	"b and l steel"		
	"bliss and laughlin"		
	"laughlin"		
	"bliss"		
DOE Hanford DDRS http://www2.hanford.gov/declass/ COMPLETED 03/22/2009	bliss & laughlin	2	0
	"bliss and laughlin"		
	"b & l steel"		
	"b and l steel"		
	"laughlin"		
	"bliss"		
	"ramco"		
	"niagara cold"		
	"cold drawn"		
	"niagara cold drawn"		
	"niagara lasalle"		
	"ramco-fitzsimmons"		
DOE OpenNet http://www.osti.gov/opennet/advancedsearch.jsp COMPLETED 03/22/2009	bliss & laughlin steel	417	1
	bliss & laughlin		
	bliss and laughlin		
	"b and l steel"		
	"ramco"		
	"niagara cold"		

Table A1-2: Database Searches for Bliss & Laughlin Steel Company			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"cold drawn"		
	"niagara cold drawn"		
	"niagara lasalle"		
	"ramco-fitzsimmons"		
	"b & l steel"		
	"bliss and laughlin"		
	"laughlin"		
	"bliss"		
DOE OSTI Energy Citations http://www.osti.gov/energycitations/ COMPLETED 03/22/2009	bliss & laughlin	2,818	0
	"niagara cold drawn"		
	"niagara lasalle"		
	"ramco-fitzsimmons"		
	"niagara cold"		
	"cold drawn"		
	"ramco"		
	"b & l steel"		
	"b and l steel"		
	"bliss and laughlin"		
	"laughlin"		
	"bliss"		
DOE OSTI Information Bridge http://www.osti.gov/bridge/advancedsearch.jsp COMPLETED 03/22/2009	bliss & laughlin	1,790	0
	"niagara cold drawn"		
	"niagara cold"		
	"cold drawn"		
	"niagara lasalle"		
	"ramco-fitzsimmons"		
	"ramco"		
	"b & l steel"		
	"b and l steel"		
	"bliss and laughlin"		
	"laughlin"		

Table A1-2: Database Searches for Bliss & Laughlin Steel Company			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"bliss"		
National Academies Press http://www.nap.edu/ COMPLETED 03/22/2009	bliss & laughlin	678	0
	"niagara cold drawn"		
	"niagara cold"		
	"cold drawn"		
	"niagara lasalle"		
	"ramco-fitzsimmons"		
	"ramco"		
	"b & l steel"		
	"b and l steel"		
	"bliss and laughlin"		
	"laughlin"		
	"bliss"		
NNSA - Nevada Site Office www.nv.doe.gov/main/search.htm COMPLETED 03/22/2009	bliss & laughlin	386	0
	bliss & laughlin		
	"niagara cold drawn"		
	"niagara cold"		
	"cold drawn"		
	"niagara lasalle"		
	"ramco-fitzsimmons"		
	"ramco"		
	"b & l steel"		
	"b and l steel"		
	"bliss and laughlin"		
	"laughlin"		
	"bliss"		
NRC ADAMS Reading Room http://www.nrc.gov/reading-rm/adams/web-based.html COMPLETED 03/22/2009	bliss & laughlin steel	1,580	2
	"niagara cold drawn"		
	"niagara lasalle"		
	"ramco-fitzsimmons"		
	"b & l steel"		

Table A1-2: Database Searches for Bliss & Laughlin Steel Company

Database/Source	Keywords	Hits	Uploaded
	"niagara cold"		
	"cold drawn"		
	"ramco"		
	"b and l steel"		
	"bliss and laughlin"		
	"laughlin"		
	"bliss"		
U.S. Transuranium & Uranium Registries http://www.ustur.wsu.edu/ COMPLETED 03/22/2009	"bliss and laughlin"	0	0
	"b & l steel"		
	"b and l steel"		
	"laughlin"		
	"bliss"		
	"ramco"		
	"niagara cold"		
	"cold drawn"		
	"niagara cold drawn"		
	bliss & laughlin		
	"niagara lasalle"		
	"ramco-fitzsimmons"		
Google http://www.google.com COMPLETED 03/20/2009	bliss laughlin	4,342	13
	bliss laughlin steel		
	"b and l steel"		
	"ramco/fitzsimmons"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "americium" OR "Am241" OR "Am-241" OR "Am 241" OR "241Am" OR "241-Am" OR "241 Am"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "ionium" OR "Th230" OR "Th-230" OR "Th 230" OR "230Th" OR "230-Th" OR "230 Th"		

Table A1-2: Database Searches for Bliss & Laughlin Steel Company			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "neptunium" OR "Np237" OR Np-237 OR Np 237 OR 237Np OR 237-Np OR 237 Np OR palm OR palmolive		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" polonium OR Po210 OR Po-210 OR Po 210 OR 210Po OR 210-Po OR 210 Po		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" thorium OR thoria OR Th232 OR Th-232 OR Th 232 OR 232Th OR 232-Th OR 232 Th OR Z metal OR Z-metal OR myrnalloy OR chemical 10-66 OR "chemical 1066" OR "chemical 10 66" OR "chemical 18-12" OR "chemical 1812" OR "chemical 18 12" OR "chemical 10-12" OR "chemical 1012" OR "chemical 10 12" OR UX1 OR UX2 OR Th-234 OR Th234 OR "Th 234" OR 234-Th OR 234Th OR "234 Th"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" tritium OR H3 OR H-3 OR mint OR HTO		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" uranium OR U233 OR U-233 OR "U 233" OR 233U OR 233-U OR "233 U" OR U234 OR "U 234" OR U-234 OR 234U OR 234-U OR "234 U" OR U235 OR "U 235" OR U-235 OR 235-U OR 235U OR "235 U" OR U238 OR "U 238" OR U-238 OR 238-U OR 238U OR "238 U" OR U308 OR "U 308" OR U-308 OR 308-U OR 308U OR "308 U" OR "black oxide" OR "brown oxide" OR "green salt" OR "orange oxide" OR "yellow cake" OR UO2 OR UO3 OR UF4 OR UF6 OR C-216 OR C-616 OR C-65 OR C-211 OR "U3O8 (uranium extraction OR uranium dioxide OR uranium hexafluoride OR uranium tetrafluoride OR uranium trioxide)"		

Table A1-2: Database Searches for Bliss & Laughlin Steel Company			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" plutonium OR Pu-238 OR Pu238 OR "Pu 238" OR 238Pu OR 238-Pu OR "238 Pu" OR Pu-239 OR Pu239 OR "Pu 239" OR 239Pu OR 239-Pu OR "239 Pu" OR Pu-240 OR Pu240 OR "Pu 240" OR 240Pu OR 240-Pu OR "240 Pu" OR Pu-241 OR Pu241 OR "Pu 241" OR 241Pu OR 241-Pu OR "241 Pu"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" radium OR Ra-226 OR Ra226 OR "Ra 226" OR 226-Ra OR 226Ra OR "226 Ra" OR Ra-228 OR Ra228 OR "Ra 228" OR 228Ra OR 228-Ra OR "228 Ra"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" radon OR Rn-222 OR Rn222 OR "Rn 222" OR 222Rn OR 222-Rn OR "222 Rn"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" thoron OR Rn-220 OR Rn220 OR "Rn 220" OR 220Rn OR 220-Rn OR "220 Rn"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" protactinium OR Pa-234m OR Pa234m OR "Pa 234m" OR 234mPa OR 234m-Pa OR "234m Pa"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" strontium OR Sr-90 OR Sr90 OR "Sr 90" OR 90-Sr OR 90Sr OR "90 Sr"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" oralloy		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" postum		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" tuballoy		

Table A1-2: Database Searches for Bliss & Laughlin Steel Company			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "uranyl nitrate hexahydrate" OR UNH		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" K-65		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "sump cake"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" accident		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "air count"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "air dust"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "air filter"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "airborne test"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" alpha		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "belgian congo ore"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" beta		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" bioassay OR bio-assay		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" breath OR "breathing zone" OR BZ		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "body burden"		

Table A1-2: Database Searches for Bliss & Laughlin Steel Company			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" calibration		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "chest count"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" collimation		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" contamination		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" curie		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" denitration OR "denitration pot"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" derby OR regulus		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "derived air concentration" OR DAC		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" dose		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" dosimeter		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" dosimetric		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" dosimetry		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" electron		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" environment		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "Ether-Water Project"		

Table A1-2: Database Searches for Bliss & Laughlin Steel Company			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "exposure" OR "exposure investigation" OR "radiation exposure"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" external		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "F machine"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" fecal		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "feed material"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" femptocurie		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" film		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" fission		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" fluoroscopy		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "Formerly Utilized Sites Remedial Action Program" OR FUSRAP		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" gamma-ray OR "gamma ray"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "gas proportional"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "gaseous diffusion"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "health (health instrument OR health physics)" OR H.I. OR HI OR HP		

Table A1-2: Database Searches for Bliss & Laughlin Steel Company			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "highly enriched uranium" OR HEU		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" hydrofluorination		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "in vitro"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "in vivo"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" incident		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" ingestion		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" inhalation		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" internal		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" investigation		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" isotope		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" isotopic		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "isotopic enrichment"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" JS Project		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" LORauer		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "liquid scintillation"		

Table A1-2: Database Searches for Bliss & Laughlin Steel Company			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "log (log sheet OR log book)"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "low enriched uranium" OR LEU		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "lung count"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "maximum permissible concentration" OR MPC		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" metallurgy		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" microcurie		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" millicurie		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "mixed fission product" OR MFP		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "monitor (air monitoring)"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" nanocurie		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "nasal wipe"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" neutron		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "nose wipe"		

Table A1-2: Database Searches for Bliss & Laughlin Steel Company			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "nuclear (Chicago-Nuclear OR nuclear fuels)"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "nuclear track emulsion type A" OR NTA		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "occupational radiation exposure"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" occurrence		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "ore concentrate"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "PC Project"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "permit (radiation work permit OR safe work permit OR special work permit)" OR "RWP OR SWP"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "phosphate research"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" photofluorography		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" photon		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" picocurie		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" pitchblende		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "pocket ion chamber" OR PIC		

Table A1-2: Database Searches for Bliss & Laughlin Steel Company			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" problem		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" procedure		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" radeco		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" radiation		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" radioactive		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" radioactivity		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" radiograph		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" radiological		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "Radiological Survey Data Sheet" OR RSDS		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" radionuclide		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" raffinate		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" reactor		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" respiratory		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "retention schedules"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" roentgen		

Table A1-2: Database Searches for Bliss & Laughlin Steel Company			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "sample (air sample OR dust sample OR general area air sample)"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "sampling (air sampling OR dust sampling OR general area air sampling)"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "solvent extraction"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "source (sealed source)"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" spectra		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" spectrograph		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" spectroscopy		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" spectrum		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "standard (operating OR processing OR etc)"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "survey (building survey OR routine OR special)"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "technical basis"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "thermal diffusion"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "thermoluminescent dosimeter" OR TLD		

Table A1-2: Database Searches for Bliss & Laughlin Steel Company			
Database/Source	**Keywords**	**Hits**	**Uploaded**
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "Tiger Team"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "tolerance dose"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "uranium aluminum alloy" OR UAlx OR "uranium aluminide"		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" urinalysis		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" urine		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "whole body count" OR WBC		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" "working level" OR WL		
	"bliss & laughlin" OR "niagara cold drawn" OR "niagara lasalle" OR "ramco-fitzsimmons" OR "b & l steel" X-ray OR "X ray" OR "Xray (x-ray screening)"		

Table A1-3: OSTI Documents Ordered for Bliss & Laughlin Steel Company			
Document Number	**Document Title**	**Requested Date**	**Received Date**
No documents ordered.			