SEC Petition Evaluation Report
Petition SEC-00200

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Petition Administrative Summary

Petition Under Evaluation

Petition #	Petition Type	Petition Receipt Date	Qualification Date	DOE/AWE Facility Name
SEC-00200	83.13	March 15, 2012	May 10, 2012	Joslyn Manufacturing and Supply Company

Petitioner-Requested Class Definition

All employees who worked in any area of the Joslyn Manufacturing and Supply Company in Fort Wayne, Indiana, from 1944 through 1952.

Class Evaluated by NIOSH

All employees who worked in any area of the Joslyn Manufacturing and Supply Company in Fort Wayne, Indiana, from March 1, 1943 through December 31, 1952.

NIOSH-Proposed Class to be Added to the SEC

All Atomic Weapons Employees who worked in any buildings/area owned by the Joslyn Manufacturing and Supply Co. in Fort Wayne, Indiana, from March 1, 1943 through July 31, 1948, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees included in the Special Exposure Cohort.

Related Petition Summary Information

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

Related Evaluation Report Information

Report Title	DOE/AWE Facility Name
SEC Petition Evaluation Report, SEC-00200, Rev. 0	Joslyn Manufacturing and Supply Company
SEC Petition Evaluation Report, SEC-00200, Rev. 1	Joslyn Manufacturing and Supply Company

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Addendum to Joslyn Manufacturing (SEC-00200) Special Exposure Cohort Evaluation Report

NIOSH presented a Special Exposure Cohort (SEC) evaluation report (NIOSH, 2012) regarding the Joslyn Manufacturing Company (Joslyn) to the Advisory Board on Radiation and Worker Health (Advisory Board) in December 2012. In its report, NIOSH evaluated the feasibility of reconstructing radiation doses of all workers who worked in any area at Joslyn during the time period of March 1, 1943 through December 31, 1952. Based on its research at that time, NIOSH defined a single class of employees for which it could not estimate radiation doses with sufficient accuracy from March 1, 1943 through December 31, 1947.

Further consideration of uranium-rolling operations at Joslyn during their high-production period through the end of July 1948 has led NIOSH to conclude that: (1) the conditions that initially led NIOSH to determine it could not perform dose reconstruction prior to 1948 continued on through July 1948; and (2) there is significantly more uncertainty regarding worker exposures in early 1948 than initially believed. The oversight and standards associated with uranium rolling were rapidly evolving from 1943 to 1948, and documentation of the assumption of responsibility for the program by the AEC is not specific on when certain protective standards and procedures were implemented. NIOSH has concluded that there is insufficient evidence to support correlating Joslyn operational conditions through July 1948 with other AEC facilities, a premise upon which the use of Battelle-TBD-6000 methods is based. The comparison of data gathered at similar AEC metal-working sites, is part of the foundation for the Battelle-TBD-6000 approach being used to assess Joslyn personnel dose. This evaluation report addendum provides NIOSH's re-evaluation of the Joslyn uranium-rolling period from January 1, 1948 through July 31, 1948, which was previously assessed in the SEC-00200 Evaluation Report and its associated revision.

NOTE: This Evaluation Report Addendum only addresses those sections in the Joslyn Manufacturing Evaluation Report that require discussion/revision; therefore, the section numbering is not contiguous. For context, some of the original surrounding text may be included with the revised text. The sections requiring additional discussion begin below.

Petition Evaluation Report Addendum Summary

Class Evaluated by NIOSH (in this Addendum)

In its initial SEC-00200 Petition Evaluation Report, NIOSH concluded that internal dose reconstruction at Joslyn was feasible for the time period from January 1, 1948 through December 31, 1952 by using the methodologies described in Battelle-TBD-6000. In that initial evaluation report, NIOSH presented air monitoring data from Joslyn from 1951 and 1952 and compared those data to air concentrations given in Battelle-TBD-6000 for similar operations.

NIOSH later concluded that the uncertainties regarding health and safety oversight and controls at the Joslyn facility during the 1948 uranium-rolling operations merited reconsideration. Standards and oversight of health and safety at uranium manufacturing facilities were rapidly evolving from 1943 to

1948. Given the limited information and lack of monitoring data for the Joslyn site, NIOSH determined that there was not enough information to adequately compare the 1952 survey data to the period of high-volume uranium rolling in 1948. NIOSH has determined that the uranium-rolling operations over this seven-month campaign were conducted during a transitional period of oversight when there was a significant throughput of uranium but a lack of clarity regarding the exposure potential from prevailing operational practices.

The uranium operations at Joslyn following the 1948 campaign were primarily in support of small AEC research programs, or in support of relatively small-scale programs. These activities were conducted in a few rolling days per year and were more consistent with the operations at the time of the 1952 time-weighted average air study at Joslyn. In this addendum, NIOSH addresses the feasibility of bounding doses from uranium exposures potentially received between January and the end of July 1948, in the context of the increased exposure potential during that period of relatively-high production. Subsequent uranium operations were significantly reduced and more consistent with the level of operations for which there are available air sample data from Joslyn.

NIOSH-Proposed Class to be Added to the SEC

Based on its continued research and consideration of the uranium-rolling operations conducted between January and the end of July 1948, NIOSH does not consider the methods described in Battelle-TBD-6000 to be sufficiently accurate for dose reconstruction at Joslyn during these months. NIOSH has therefore expanded the class of employees for which NIOSH recommends inclusion in the SEC. The NIOSH-proposed class now extends to all Atomic Weapons Employees who worked in any buildings/area owned by the Joslyn Manufacturing and Supply Co. in Fort Wayne, Indiana, from March 1, 1943 through July 31, 1948, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees included in the Special Exposure Cohort.

The NIOSH-proposed class does not comprise the entire evaluated class because NIOSH finds it is feasible to perform sufficiently accurate dose reconstruction from August 1, 1948 through the end of the covered period of radiological operations on December 31, 1952, using the methods described in Section 7.2 of the SEC-00200 Evaluation Report and further described within Battelle-TBD-6000.

Feasibility of Dose Reconstruction

NIOSH finds that it is not feasible to estimate internal exposures with sufficient accuracy for all workers at the site from March 1, 1943 through July 31, 1948. The limited air sampling conducted in 1943 and 1944 were based on mass samples collected by electrostatic precipitation. NIOSH does not have adequate information regarding the accuracy and uncertainties of this methodology and is not fully aware of the limitations and biases associated with this sample collection method. NIOSH has acquired very limited air sampling data from Joslyn. These data are only available for the years 1943, 1944, 1951, and 1952. Air sample data for similar operations at Simonds Saw and Steel are available (Site Visit, Oct1948; Site Visit, Dec1948) and are supporting results used in the development of Battelle-TBD-6000; however, the lack of specific documentation on the health and safety oversight and conditions at Joslyn during the 1948 uranium-rolling campaign raises questions about whether the

Simonds data are representative of Joslyn conditions through July 1948. In addition, Joslyn made unsuccessful attempts to reduce airborne contamination during grinding operations through the use of tenting structures. These efforts introduce uncertainty into the 1943-1944 monitoring data (e.g., due to possible perturbations in airflow and air exchange).

Ultimately, there are no air monitoring data that NIOSH considers adequately representative of Joslyn uranium operations from 1943 through July 1948 that can be used to support a bounding dose estimate that is sufficiently accurate. There have been no personnel monitoring data located that could be used to support the limited air monitoring results. NIOSH is not able to establish confidence in the ability to perform sufficiently accurate dose reconstruction based on the available data associated with the uranium operations at Joslyn Manufacturing and Supply Co. beginning in March 1943 through July 1948.

The data upon which Battelle-TBD-6000 bases its methods and conclusions are applicable to rolling and machining operations and can be sufficiently equated to the uranium operations conducted at Joslyn when rolling became limited in volume after the 1948 rolling campaign, and thus more comparable to conditions at the time of the 1952 Joslyn monitoring data. The TBD data were collected starting in 1948 with the studies at Simonds Saw and Steel (Simonds, 1948-1949, pdf pp. 249-254; Site Visit, Oct1948; Site Visit, Dec1948). These data were used to establish dose estimation procedures found in Battelle-TBD-6000, which NIOSH believes are sufficient to bound the potential exposures associated with work at Joslyn from August 1948 through December 1952 with sufficient accuracy. With the exception of the class defined for March 1943 through July 1948, per EEOICPA and 42 C.F.R. § 83.13(c)(1), NIOSH concludes that it has established that it has access to sufficient information to: (1) estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred in plausible circumstances by any member of the class; or (2) estimate radiation doses more precisely than an estimate of maximum dose. Information available from Battelle-TBD-6000 and additional resources are 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 from August 1, 1948 through December 31, 1952.

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

- NIOSH finds that it is likely feasible to reconstruct occupational medical dose for Joslyn Manufacturing and Supply Company workers with sufficient accuracy.

- Principal sources of internal radiation for members of the proposed class included exposures to uranium and uranium oxides released into the work environment during the production and shaping of uranium metal rods. The modes of exposure were inhalation and ingestion during the processing of these metals.

- In addition, there was potential for internal exposure to airborne thorium released on two days as a result of experimental centerless grinding of thorium rods in 1946 and early 1947.

- Based on insufficient information regarding operations and air monitoring during the years of process development (1943-1947), NIOSH originally concluded that sufficiently accurate internal dose reconstruction for the period from March 1, 1943 through December 31, 1947, is not feasible.

- Uncertainties regarding health and safety oversight and controls at the Joslyn facility during the 1948 uranium-rolling operation merited further consideration by NIOSH. Joslyn was initially under control and oversight of the MED. The MED operated facilities under different health and safety standards than those applied later by the AEC at other uranium metal-working sites (e.g., Simonds Saw and Steel). The sites with AEC oversight have air monitoring data available for comparison.

- Between January and the end of July 1948, Joslyn operated under a heavy rolling schedule. Indications are that the three Joslyn mills rolled multiple uranium rods in a fairly simultaneous manner (Site Visit, Mar1948). The three mills were in close physical proximity. All this suggests an exposure environment during these months that is not readily comparable to other sites or operations. NIOSH has no air monitoring data that it considers adequately representative of this rolling campaign to verify the exposure environment. The reduced rates of uranium rolling after July 1948 are less likely to have required simultaneous rollings on the closely-located rolling mills.

- The lack of site air monitoring data during Joslyn's period of high uranium throughput through July 1948, in combination with NIOSH's inability to reconcile site-specific differences between Joslyn data collected under MED oversight and the data supporting Battelle-TBD-6000 intake models collected at sites under AEC oversight, lead NIOSH to conclude that sufficiently accurate internal dose reconstruction for the period from January 1, 1948 through July 31, 1948 is also not feasible. However, NIOSH has identified sufficient information and air monitoring data that can be assessed using existing dose reconstruction methods defined in Battelle-TBD-6000 to support bounding internal dose for the period from August 1, 1948 through December 31, 1952.

- Principal sources of external radiation for members of the proposed class included exposures to gamma and beta radiation associated with handling and working in proximity to natural uranium and thorium metals during machining operations. The modes of exposure were direct radiation, submersion in potentially-contaminated air, and exposure to contaminated surfaces.

- NIOSH has determined that reconstruction of external doses for Joslyn workers is feasible using the assumptions and approaches presented in Battelle-TBD-6000.

- Pursuant to 42 C.F.R. § 83.13(c)(1), NIOSH determined that there is insufficient information to either: (1) estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the radiation doses of members of the class more precisely than a maximum dose estimate for the period at Joslyn Manufacturing and Supply Co. from March 1, 1943 through July 31, 1948.

- Although NIOSH found that it is not possible to completely reconstruct radiation doses for the proposed class, NIOSH intends to use any internal and external monitoring data that may become available for an individual claim and that can be interpreted using existing NIOSH dose reconstruction processes or procedures. Therefore, dose reconstructions for individuals employed at Joslyn Manufacturing during the period from March 1, 1943 through July 31, 1948, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

- NIOSH concludes pursuant to 42 C.F.R. § 83.13(c)(1), that there is sufficient information to either: (1) estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the radiation doses of members of the class more precisely than a maximum dose estimate for the period at Joslyn from August 1, 1948 through December 31, 1952.

Health Endangerment Determination

NIOSH did not identify any evidence supplied by the petitioners or from other resources that would establish that the proposed class was exposed to radiation during a discrete incident likely to have involved exceptionally high-level exposures. However, evidence indicates that some workers in the proposed class may have accumulated substantial chronic exposures through episodic intakes of radionuclides, combined with external exposures to beta and gamma radiation. Consequently, NIOSH has determined that health was endangered for those workers covered by this evaluation who worked from March 1, 1943 through July 31, 1948, and were employed for at least 250 aggregated work days either solely under their employment or in combination with work days within the parameters established for other SEC classes.

For the period August 1, 1948 through December 31, 1952, 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.

3.2 Class Evaluated by NIOSH

During the initial evaluation of the operations at Joslyn, NIOSH evaluated all employees who worked in any area of the Joslyn Manufacturing and Supply Company in Fort Wayne, Indiana, from March 1, 1943 through December 31, 1952 and found a class of employees who worked at the facility between March 1, 1943 and December 31, 1947 for which NIOSH could not estimate radiation doses with sufficient accuracy. NIOSH believed it was feasible to perform sufficiently accurate dose reconstruction from January 1, 1948 through December 31, 1952, when radiological operations had ceased.

Further consideration of uranium-rolling operations at Joslyn during their high-production period through July 1948 has led NIOSH to conclude that there is significantly more uncertainty regarding worker exposures than initially believed. Standards and oversight of health and safety at uranium manufacturing facilities rapidly evolved from 1943 to 1948. Since its initial evaluation, NIOSH has determined that the 1952 Joslyn survey data and the air concentrations for similar operations given in

Battelle-TBD-6000 may not be representative of the conditions prevailing during Joslyn's high-volume uranium rolling campaign in 1948. NIOSH has determined that the uranium-rolling operations over this seven-month campaign (through July 1948) were conducted during a transitional period of oversight when there was a considerable throughput of uranium but a lack of clarity regarding the exposure potential from prevailing operational practices.

The uranium operations following this 1948 campaign were primarily in support of small AEC research programs or in support of relatively small-scale programs. These activities were conducted in a few rolling days per year and were more consistent with the operations at the time of the 1952 time-weighted average air study at Joslyn. In this addendum, NIOSH addresses the feasibility of bounding doses from uranium exposures potentially received between January and the end of July 1948, in the context of the increased exposure potential during that period of relatively-high production. Subsequent uranium operations were significantly reduced and more consistent with the level of operations for which there are available air sample data from Joslyn.

3.3 NIOSH-Proposed Class to be Added to the SEC

Based on its research of the class under evaluation, NIOSH has defined a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. The NIOSH-proposed class to be added to the SEC includes all Atomic Weapons Employees who worked in any buildings/area owned by the Joslyn Manufacturing and Supply Co. in Fort Wayne, Indiana, from March 1, 1943 through July 31, 1948, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees included in the Special Exposure Cohort.

4.1 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.

Although Joslyn Manufacturing had a significant part in the development of rolling techniques early in the Manhattan Engineer Project's (MED) work, it was a small part of the overall project. No Site Profile has been developed for Joslyn. However, Battelle-TBD-6000 includes information and assumptions used to provide generic historic background information and guidance to assist the preparation of dose reconstructions for this category of sites. Specifically, Battelle-TBD-6000 relies on the experience and air dust studies from other AEC controlled sites, including Simonds Saw and Steel, which also rolled and worked natural uranium beginning in February 1948, following very similar processes used at Joslyn. Using information from sites within the uranium metal-working complex, Battelle-TBD-6000 provides an exposure matrix for workers at AWE facilities that performed metal-working operations with uranium metal, and includes general discussions of

operations and exposure conditions at uranium metal-working facilities. Therefore, as part of NIOSH's evaluation detailed herein, it examined the following TBDs for insights into Joslyn Manufacturing operations or related topics/operations at other sites:

- *Site Profile for Simonds Saw and Steel*; ORAUT-TKBS-0032, Rev.01; April 18, 2011; SRDB Ref ID: 94105

- *Site Profiles for Atomic Weapons Employers that Worked Uranium Metals*, Battelle-TBD-6000, Rev.01; Division of Compensation Analysis and Support; June 17, 2011; SRDB Ref ID: 101251

- *Site Profiles for Atomic Weapons Employers that Worked Uranium Metals and Thorium Metals-Appendix BB, General Steel Industries*, Battelle-TBD-6000, Rev.00; Office of Compensation Analysis and Support (now Division of Compensation Analysis and Support); June 25, 2007; SRDB Ref ID: 47713

5.1 Joslyn Manufacturing Plant and Process Descriptions

Considerable early work at Joslyn Manufacturing was for the purpose of determining the best procedures for rolling and machining natural uranium rods, which made it necessary that the procedures changed over time; however, the basic process remained fairly consistent. Natural uranium billets were received by rail at Joslyn Manufacturing, unloaded by an overhead crane onto carts, and stored in a storage area. The billets were taken, as needed, from the storage area to the tempering area, pre-heated in one of eight small natural-gas-atmosphere electric furnaces to a specified temperature, and moved to the rolling mills (an 18-inch roughing stand, 12-inch intermediate mill, and a 9-inch finishing mill were used) where passes occurred (Army Corps, 2005, pdf pp. 6-7). These rolling mills were located in close proximity in one large area, approximately 25 feet from the furnaces. Time was allowed for the rolls to cool between passes in order to prevent the metal from exceeding a specified temperature.

5.2 Radiological Exposure Sources from Joslyn Operations

5.2.1 Internal Radiological Exposure Sources from Joslyn Operations

5.2.1.1 Natural Uranium

The principal sources of internal exposure to the natural uranium processed at Joslyn were from the inhalation of dust, oxide scale, or fumes generated during various machining operations including straightening, rolling, cutting and centerless grinding. These activities occurred in Buildings 6, 7, 8, and 9.

Rolling operations were capable of releasing large quantities of uranium dust into the atmosphere. Uranium readily oxidizes when exposed to air at temperatures above 600° F. The oxide scale formed on the surface spontaneously flakes off at elevated temperatures and is easily disturbed upon handling. The oxide formation and flaking produces high air concentrations and dust collection on the

workplace floor and other surfaces. Any worker movement on a dusty floor will re-suspend dust into the air, thus creating elevated air concentrations after the rolling has stopped (Battelle-TBD-6000). Documentation states: "The bearings (bronze inserts) on the rolls are water cooled and packed with an exceptionally heavy "Roll Neck" grease" (Site Visit, Mar1948, pdf p. 4). The use of water on uranium at temperatures on the order of 1100º F were necessary during the rolling process and would generate significant steam and suspend uranium into the air around the rolling operations (Site Visit, 1944). This same document describes a 'haze or smoke' high in the room and a varying amount of dust and steam is produced.

After rolling, machining processes were used to reduce the rods to the required diameter and to finish the surface. These machining processes included lathe operations, centerless grinding, cutting, and threading. Because the metal is typically near room temperature for machining, surface oxides are not formed or loosened during machining to the extent that they are during rolling. The biggest generator of uranium dust associated with machining was probably the ignition of small chips and turnings that were generated during machine operations (Battelle-TBD-6000, pdf p. 16). At Joslyn, due to the pyrophoric nature of the uranium, a heavy flow of coolant was used over the cutting/grinding surfaces to minimize sparking. These measures would likely have also reduced the airborne concentrations to some degree. While the rolling operations were generally open in the mill buildings, the grinding and cutting operations were to be ventilated through the use of a small shed enclosure within the larger building. The grinder had an overhead hood connected to a fan and discharge was into the inside of the larger shed. During MED/AEC surveys the air concentrations around the centerless grinder were still found to be unacceptable and apparently this ventilation was not sufficient to meet the standards in effect at the time.

As billets and rods were moved between the operational areas any dragging or dropping of the hot metal could have resulted in airborne radioactivity and the potential for intakes.

Operations and the clean-up of accumulated dust and fragments resulted in an accumulation of waste uranium metal that had to be accounted for. For accountability purposes, efforts were made to collect the residual cuttings and dust using steel pans to collect shavings and trimmings and by brushing the steel floor plates before, during, and after cutting work. The practice at Joslyn was to burn the waste material so that it would be in the less combustible oxide form for shipment back to the AEC. NIOSH is aware that former workers report that burning operations were performed outdoors by one individual (Personal Communication, 2012). These former workers reporting on burn operations had work history at the site beginning in 1948 through covered operations. The 1950 Kehoe report describes dry burning as the most expeditious and least expensive method for disposal of uranium scraps by conversion to oxide and states for a quantity not exceeding 5 pounds, the scrap may be spread out on a steel plate in an open area and burned to oxide by the flame of an oxy-acetylene torch (Kehoe, 1950). Burning uranium metal fines and shavings outdoors creates environmental problems, but would have tended to reduce the airborne concentrations versus burning in a confined area, such as a building.

Since Joslyn only performed work for MED/AEC through 1952, there was no potential for recycled uranium processing (Battelle-TBD-6000, pdf p. 14).

6.1 Available Joslyn Internal Monitoring Data

NOTE: Section 6.1 spans six pages. Only the following tables are addressed in this addendum, to correct values/units.

Table 6-1: Available Uranium Air Sample Results for the Joslyn Operational Period
(This table spans two pages)

Date	Description of Activity	Location	Value (pCi/m^3)	Reference
12/7/1943	Uranium - Centerless Grinding	GA – in path of fumes	Range = 215 – 6,156 Avg = 3,186	11036
		GA - outside of grinding shed	616	11036
		GA - outside of grinding shed, after grinding stopped	68	11036
5/8/1944	Uranium - Rolling	GA – furnace area	802	5890
		GA – at rolling machine	1,499	5890
		GA – general room air	1,197	5890
10/24/1951	Uranium - Centerless Grinding/Cutting	GA – general area	Range = 14 – 23 avg = 20	11036
		BZ – operator	Range = 14-811 avg = 486	11036
1/8/1952	Uranium Rolling	GA – production areas	Range = 3.5 – 1,744 Avg = 355 GM = 107 GSD = 6.45 95^{th} %ile = 2302	9664
		BZ – production areas	Range = 6.5 – 17,672 Avg = 2,052 GM = 350 GSD = 7.84 95^{th} %ile = 10,355	9664
	Centerless Grinding	GA – production areas	Range = 5.3 - 60 Avg = 29 GM = 23 GSD = 2.31 95^{th} %ile = 90	9664
		BZ – production areas	Range = 1.9 - 277 Avg = 42 GM = 19 GSD = 3.27 95^{th} %ile = 134	9664
	Cutting	GA – production areas	Range = 4.4 - 246 Avg = 82 GM = 30 GSD = 5.58 95^{th} %ile = 503	9664
		BZ – production areas	Range = 25 - 258 Avg = 107 GM = 88 GSD = 1.99 95^{th} %ile = 273	9664

Table 6-1: Available Uranium Air Sample Results for the Joslyn Operational Period (This table spans two pages)				
Date	**Description of Activity**	**Location**	**Value (pCi/m^3)**	**Reference**
	Lathe Operations	GA – production areas	Range = 0.38 – 3.1 Avg = 1.6 GM = 1.2 GSD = 2.63 95th %ile = 5.8	9664
		BZ – production areas	Range = 1.7 – 74 Avg = 20 GM = 8.3 GSD = 4.20 95th %ile = 88	9664

Table 6-2: Results of a 1952 Time-Weighted Average Exposure Study		
Work Area / Job Description	**Time Weighted Average Exposure**	
	(dpm/m^3)	**(pCi/m^3)**
18" rough roll east	3322	1496
18" rough roll west	375	169
Roller Forman	725	327
Asst Roller (Ass't Foreman)	725	327
Furnace Heaters	16	7
Recorder	16	7
12" rough Roll East	605	273
12" rough Roll West	570	257
Drag Down (Billet)	310	140
9" finishing roll east	16542	7451
9" finishing roll west	5791	2609
Quench Tank	155	70
Draggers	831	374
Rod Stamper	242	109
Rod Bundler	128	58
Lathe Operation	12	5
Centerless Grinder	100	45
Grinder (portable)	277	125
Cutomatic	191	86

7.1 Pedigree of Joslyn Data

7.1.1 Internal Monitoring Data Pedigree Review

In this evaluation, NIOSH has determined that it lacks sufficient data relating to worker internal doses from AEC-related work performed at Joslyn Manufacturing and Supply Co. during part of the operational period; from March 1, 1943 through July 31, 1948. Therefore, a complete internal data sufficiency and pedigree evaluation is not possible for the period from March 1, 1943 through July 31, 1948.

Data for AEC-related uranium work, for the period from August 1, 1948 through December 31, 1952, consist of work place air monitoring survey reports and information regarding work practices consistent with other rolling operations. These sources are copies of original reports and are therefore considered primary data sources. Data collection performed by AEC representatives would have been in accordance with standard practices using state-of-the-art methods during that time period.

7.2 Evaluation of Bounding Internal Radiation Doses at Joslyn

7.2.1 Evaluation of Bounding Process-Related Internal Doses

7.2.1.1 Uranium Airborne Levels

During the operational period, air samples were taken on at least four occasions during uranium work (see Section 6.1). The air samples were not consistently taken in the same areas; furthermore, information is generally lacking on the relationship of the sample locations to the areas occupied by workers with the exception of samples labeled “BZ” (i.e., breathing zone). Some of the air concentrations were quite high compared to the desired limit or “tolerance” values in use during the early part of the operational period (150 µgm uranium) (Fuqua, 1944). Comparison of air samples across the operational period is problematic because the tolerance levels changed, the sampling methods changed, uranium dust control practices changed, and practices changed in order to incorporate experience gained both at Joslyn and other facilities for the purposes of improving health conditions, reducing the potential for fire, and to better meet the specifications for the products. Early air samples were collected (Chipman, 1943), but the reports do not provide details on the collection medium or the efficiency of the counting methods. The reports did mention that throughout the operations the engineering controls were not effective in controlling the airborne contamination (Klevin, 1952).

Under close scrutiny, the limited and intermittent air sample results collected in 1943 and 1944 do not meet the criteria for being sufficient to support establishing a bounding dose estimate for uranium internal exposures. The samples during this period are in the nature of a snapshot of the conditions during a time of testing and evaluation. NIOSH does not have the supporting documentation to establish confidence in the sampling methods or to account for uncertainties possibly introduced by the sampling methodologies and by the introduction of the tenting structures over the grinding operations. NIOSH cannot justify considering these samples to be either representative of the

machining activities of the period or indicative of the highest exposure conditions to which Joslyn workers were potentially subjected.

When the monitoring data available for a site are sparse, NIOSH can rely on information, techniques, and data provided by the AEC's Health and Safety Laboratory (HASL). In 1948, HASL was being formed as a small central laboratory facility for assisting contractors who could not adequately perform the necessary industrial hygiene and industrial functions. HASL began monitoring AEC programs and began recommending mitigation plans for uranium metal-working industrial facilities. The procedural monitoring methods developed and used by HASL were eventually detailed in HASL-300, *EML Procedures Manual* (originally issued in 1957, now in its 28th edition) (HASL-300). HASL descriptions of methods and background on air monitoring and exposure assessment provide a foundation for a historical understanding of the types of samples taken, how they were taken, how they were analyzed, and how the results were interpreted. This information allows NIOSH to interpret what such results represent as well as the uncertainties associated with the collected samples. NIOSH has confidence in the HASL sampling procedures and protocols as well as an understanding of the uncertainty associated with the air sampling methods implemented by HASL and the data resulting from HASL methods.

In 1948, Joslyn began the largest production-scale uranium-rolling campaign of its operations, conducted under the supervision of Hanford, with no known changes to protocols. Because there are no site-specific data for Joslyn from 1948 until the 1951-1952 timeframe, NIOSH uses HASL data for similar sites to put an upper boundary on potential dose at Joslyn during the limited uranium-rolling operations between August 1948 and December 1952. However, between January and the end of July 1948 the heavy rolling schedule and proximity of the three Joslyn mills, all operating in a fairly simultaneous manner (Site Visit, Mar1948), suggests an exposure environment during these months that is not readily comparable to other sites or operations in the absence of monitoring data for verification.

After the completion of the 1948 heavy-rolling campaign, Joslyn uranium operations were reduced to a level comparable to the operations performed in 1952. NIOSH has compared the 1952 air data to Battelle-TBD-6000 to verify the bounding nature of the TBD approach for determining Joslyn worker exposures. The lower level of production after July 1948 makes it possible to reasonably and appropriately compare the Joslyn data collected using HASL techniques with Battelle-TBD-6000 results for metal-working operations conducted at similar sites.

During the steel rolling operations (non-MED/AEC work), Joslyn workers could have potentially been exposed to re-suspended uranium from incompletely-decontaminated surfaces. Though respirators were recommended for workers directly involved in MED/AEC work (Fuqua, 1944; Cantril, 1944), there are indications of poor compliance with respirator use (Site Visit, 1944). Respirator use was unlikely to have been required during non-MED/AEC work when re-suspension could have produced exposures. In any case, NIOSH does not consider the protection that may have been provided by respirator use during dose reconstructions.

7.2.3 Methods for Bounding Operational Period Internal Dose at Joslyn

Internal dose estimates for the operational period from August 1, 1948 through December 31, 1952, can be based on the inhalation and ingestion intakes in Battelle-TBD-6000. Process information as well as the comparison of Joslyn data from 1952 with Battelle-TBD-6000 data from other sites support the premise that the TBD data are bounding for Joslyn exposures from August 1948 through 1952. The TBD provides an exposure matrix for workers at AWE facilities that performed metal-working operations with uranium metal. For some sites, an appendix was developed which contains site-specific information that can be used for dose reconstruction. For sites like Joslyn, information that can be used to perform dose reconstructions is provided in the main body of Battelle-TBD-6000.

Table 7-1: Comparison of 1952 Time-weighted Average (TWA) Study with Battelle-TBD-6000

Joslyn Work Area/Job Description	TWA (pCi/m^3)	Battelle-TBD-6000 Equivalent Description	GM (pCi/m^3)	95% (pCi/m^3)	AM (pCi/m^3)
18" rough roll east	1496	Rolling Operator	1606	22675	5864
18" rough roll west	169	Rolling Operator	1606	22675	5864
Roller Forman	327	Rolling Supervisor	148	2090	540
Asst Roller (Ass't Foreman)	327	Rolling Supervisor	148	2090	540
Furnace Heaters	7	Rolling General Labor	296	4179	1081
Recorder	7	Rolling General Labor	296	4179	1081
12" rough Roll East	273	Rolling Operator	1606	22675	5864
12" rough Roll West	257	Rolling Operator	1606	22675	5864
Drag Down (Billet)	140	Rolling General Labor	296	4179	1081
9" finishing roll east	7451	Rolling Operator	1606	22675	5864
9" finishing roll west	2609	Rolling Operator	1606	22675	5864
Quench Tank	70	Rolling General Labor	296	4179	1081
Draggers	374	Rolling General Labor	296	4179	1081
Rod Stamper	109	Rolling General Labor	296	4179	1081
Rod Bundler	58	Rolling General Labor	296	4179	1081
Lathe Operation	5	Machining Operator	2491	35171	9096
Centerless Grinder	45	Machining Operator	2491	35171	9096
Grinder (portable)	125	Machining Operator	2491	35171	9096
Cutomatic	86	Machining Operator	2491	35171	9096

Table 7-2: Comparison of 1951 Air Concentrations to Battelle-TBD-6000

Joslyn Work Area/Job Description	Average (pCi/m^3)	Maximum (pCi/m^3)	Battelle-TBD-6000 Equivalent Description	GM (pCi/m^3)	95% (pCi/m^3)	AM (pCi/m^3)
Centerless grinding 1951 general area	20	23	Machining Operator 1/1/1951 to 12/31/55	2491	35171	9096
Centerless grinding 1951 operator	486	811	Machining Operator 1/1/1951 to 12/31/55	2491	35171	9096

NOTE: Section 7.2.3 goes on to detail the method for four pages.

7.2.4 Internal Dose Reconstruction Feasibility Conclusion

NIOSH concludes it is not feasible to reconstruct uranium internal radiation doses with sufficient accuracy for the period from March 1, 1943 through July 31, 1948 at Joslyn.

NIOSH concludes that there are site specific data and existing dose reconstruction methods available in Battelle-TBD-6000 to support reconstructing internal radiation doses with sufficient accuracy for the period from August 1, 1948 through December 31, 1952.

Although NIOSH found that it is not possible to completely reconstruct internal radiation doses for the period from March 1, 1943 through July 31, 1948, NIOSH intends to use any internal monitoring data that may become available for an individual claim (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures). Therefore, dose reconstructions for individuals employed at Joslyn during the period from March 1, 1943 through July 31, 1948, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

7.3 Evaluation of Bounding External Radiation Doses at Joslyn

7.3.5 External Dose Reconstruction Feasibility Conclusion

There are methods available to NIOSH to support bounding external uranium and thorium dose for the operational period at Joslyn. NIOSH has identified sufficient information or data to support the bounding conclusion.

For the operational period, NIOSH was unable to determine a worker's actual work locations or whether a worker was restricted to one location. Workers may have been able to move about freely; therefore, all workers' exposures will be treated similarly.

The uranium and thorium activities at Joslyn were consistently routine over time and therefore the exposures to workers can be extrapolated from a snapshot in time. Therefore, NIOSH has determined that reconstruction of external doses for Joslyn workers with sufficient accuracy, including occupational medical dose, is feasible for the operational period from March 1, 1943 through December 31, 1952.

7.4 Evaluation of Petition Basis for SEC-00200

7.4.1 Unmonitored Radiation Exposures

SEC-00200: (F.1) Radiation exposures and radiation doses potentially incurred by members of the proposed class were not monitored either through personal monitoring or through area monitoring.

NIOSH determined that it has access to only a limited number of air sample and source term information for Joslyn during the time period under evaluation. Medical records, bioassay data, and external monitoring results are not available. NIOSH has concluded that the available information is insufficient to bound the internal dose for Joslyn early operations from March 1, 1943 through July

31, 1948; however, the internal dose from August 1, 1948 through December 31, 1952 can be bound using the approaches described in Battelle-TBD-6000, as discussed within this evaluation report.

7.5 Summary of Feasibility Findings for Petition SEC-00200

This report evaluates the feasibility for completing dose reconstructions for employees at the Joslyn Manufacturing and Supply Co. from March 1, 1943 through July 31, 1948. NIOSH found that the available monitoring records, process descriptions, and source term data available are not sufficient to complete dose reconstructions for the entire evaluated class of employees.

Table 7-4 summarizes the results of the feasibility findings at Joslyn for each exposure source during the time period from March 1, 1943 through July 31, 1948 and from August 1, 1948 through December 31, 1952.

Table 7-4: Summary of Feasibility Findings for SEC-00200
March 1, 1943 through July 31, 1948;
August 1, 1948 through December 31, 1952

Source of Exposure	March 1, 1943 through July 31, 1948		August. 1, 1948 through December 31, 1952	
	Reconstruction Feasible	**Reconstruction Not Feasible**	**Reconstruction Feasible**	**Reconstruction Not Feasible**
Internal[1]		**X**	**X**	
- Uranium		X	X	
- Thorium		X	N/A	
External	**X**		**X**	
- Gamma	X		X	
- Beta	X		X	
- Neutron	N/A	N/A	N/A	N/A
- Occupational Medical X-ray	X		X	

[1] Internal includes an evaluation of airborne dust data

As of December 13, 2013, a total of 70 claims have been submitted to NIOSH for individuals who worked at Joslyn during the period under evaluation in this report. Thirteen of these claims have been pulled from further consideration because they fall within the parameters of the SEC, thus leaving 57 claims. Dose reconstructions have been completed for 56 of these individuals (~98%).

Although NIOSH found that it is not possible to completely reconstruct radiation doses for the proposed class, NIOSH intends to use any internal and external monitoring data that may become available for an individual claim (and that can be interpreted using existing NIOSH dose reconstruction processes or procedures). Therefore, dose reconstructions for individuals employed at Joslyn during the period from March 1, 1943 through July 31, 1948, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate.

8.0 Evaluation of Health Endangerment for Petition SEC-00200

Based on the sum of information available from available resources, NIOSH's evaluation determined that it is not feasible to estimate radiation dose with sufficient accuracy for members of the NIOSH-evaluated class for the time period from March 1, 1943 through July 31, 1948. Therefore, the resulting NIOSH-proposed SEC class must include a minimum required employment period as a basis for specifying that health was endangered for this time period. NIOSH further determined that it is feasible to estimate radiation dose with sufficient accuracy for members of the NIOSH-evaluated class for the time period from August 1, 1948 through December 31, 1952. Therefore, a health endangerment determination is not required for this time period.

9.0 Class Conclusion for Petition SEC-00200

Based on its full research of the class under evaluation, NIOSH has defined a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. The NIOSH-proposed class to be added to the SEC includes all Atomic Weapons Employees who worked in any buildings/area owned by the Joslyn Manufacturing and Supply Co. in Fort Wayne, Indiana, from March 1, 1943 through July 31, 1948, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees included in the Special Exposure Cohort.

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