Division of Compensation Analysis and Support	Document Number: Battelle-TBD-6000 Appendix J Effective Date: 10/07/2014 Revision No. 0

Site Profiles for Atomic Weapons Employers that Worked Uranium Metals

Appendix J – Joslyn

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Approval: Signature on file Date: 10/07/2014 Supersedes: None

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RECORD OF ISSUE/REVISIONS			
ISSUE AUTHORIZATION DATE	**EFFECTIVE DATE**	**REV. NO.**	**DESCRIPTION**
8/08/2014	10/07/2014	0	Appendix to Battelle-TBD-6000 describing the use of the TBD for claims at Joslyn

J.1 Introduction

This document serves as an appendix to Battelle-TBD-6000, *Site Profiles for Atomic Weapons Employers that Worked Uranium Metals*. This appendix describes the results of document research specific to this site. Where specific information is lacking, research into similar facilities described in the body of this Site Profile is used.

J.2 Site Description

Joslyn Manufacturing and Supply Company, also known as Joslyn Stainless Steel Company, Fort Wayne Steel Corporation, and Slater Steel, performed tempering, hot rolling, quenching, straightening, cooling, grinding, waste burning, and abrasive cutting of natural uranium billets into metal rods for use in Hanford site nuclear reactors (ORAU 2012). Joslyn Manufacturing was instrumental in developing the procedures for rolling uranium metal rods. These activities were conducted in support of the Manhattan Engineer District (MED) from March 1, 1943 through December 31, 1952.

J.2.1 Site Activities

Uranium Processing

Considerable early work at Joslyn Manufacturing was for the purpose of determining the best procedures for rolling and machining natural uranium rods. Natural uranium billets were received by rail, 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. Time was allowed for the rolls to cool between passes in order to prevent the metal from exceeding a specified temperature (ORAU 2012, pg. 18).

The grinding process was carried out in two widely separated parts of a large shed. The first operation consisted of grinding uranium rods. This process was carried out in 1943 and 1944 in a small shed constructed inside a larger shed. The fumes and dust from this smaller shed were vented into the atmosphere of the larger shed. The second operation was a rough cut on the uranium rods inside of the smaller shed. The rods were cropped and moved to the threading area, where they were milled and machined to contract specifications (ORAU 2012, pg. 18).

Production scale rolling of uranium billets was conducted in 1944 during three periods; 60,122 pounds between May 9-11; 5,900 pounds on June 2, and 64,725 pounds between June 22-24 (ORAU 2012). Production scale rolling was also conducted in 1947 on August 5th and 6th involving 10 tons of uranium billets. Additional campaigns occurred from February through June in 1948 involving approximately 290 tons of uranium billets (ORAU 2012). It is unclear if all of this material was actually rolled at Joslyn Manufacturing; documents indicated that rolling activities also occurred at the Simonds Saw and Steel Company. Additional rolling and machining of uranium metal is listed in tables J.5 and J.6 at the end of this Appendix.

Thorium Processing
Two distinct thorium processing activities occurred at Joslyn Manufacturing. On June 21, 1946 an MED monthly report describes the straightening and centerless grinding of six thorium rods (ORAU 2012). These rods were straightened and centerless ground cold on a Medart straightening machine. Following straightening, the rods were cleaned up by centerless grinding.

A January 21, 1947 MED report describes the centerless grinding of five extruded thorium rods. The rods were extruded at Revere Copper and Brass and then sent to Joslyn Manufacturing.

An August 11, 1947 memo discusses possible thorium rolling at Joslyn Manufacturing; however the memo goes on to state that Joslyn would not be viable for the thorium rolling work.

J.2.2 Special Exposure Cohort
The Secretary of Health and Human Services designated a Special Exposure Cohort (SEC) for Joslyn on March 6, 2013. On March 27, 2014, the Secretary designating an additional SEC that extended the designated period for Joslyn. SEC-00200 now designates all employees that worked for Joslyn at the Fort Wayne covered facility between March 1, 1943 and July 31, 1948.

NIOSH has concluded that it is not feasible to reconstruct internal radiation doses with sufficient accuracy for the period from March 1, 1943 through July 31, 1948 at Joslyn Manufacturing Company (ORAU 2012, ORAU 2014).

Any available personal monitoring data should be used to reconstruct an individual's exposure at Joslyn Manufacturing during this time period. However, unmonitored internal exposures during this time period cannot be reconstructed.

J.2.3 Production Rate
The exposure to the uranium metal was not a continuous exposure over the course of the year. Specific data exists for the number of uranium work days at Joslyn. Tables J.5 and J.6 at the end of this Appendix lists the data for uranium rolling days and uranium machining days, respectively. The number of days for each type of work is tallied in table J.1. Estimates of exposure to rolling or machining were combined with the specific number of days each was performed to arrive at an annual exposure estimate. For many of the work days, both types of work were performed but individual workers would not perform both types of work simultaneously. For those days, the estimate will use the higher exposure type of work (machining or rolling) to estimate the dose.

Table J.1 – Uranium Working Days

Year	Work Days				
	Rolling Only	**Machining Only**	**Rolling + Machining**	**Workdays**	**Non-rolling / machining workdays**
1943[a]	1	16	1	208	190
1944	27	10	6	250	207
1945	0	0	54	250	196
1946	0	1	32	250	217
1947	0	0	12	250	238
1-7/1948	0	8	67	146	71
8-12/1948	10	0	0	104	94
1949	2	0	0	250	248
1950	8	3	0	250	239
1951	1	1	0	250	248
1952	3	1	0	250	246

a Work started in March of 1943

J.3 Occupational Medical Dose

No detailed information regarding occupational medical dose was found in any of the site research or telephone interviews. Information to be used in dose reconstructions, for which no specific information is available, is provided in ORAUT-OTIB-0006 (ORAU 2011), the technical information bulletin covering diagnostic x-ray procedures. This estimate will assume each employee received one AP chest x-ray each year of the covered period which includes 1943 through 1952.

J.4 Occupational Internal Dose

There are no bioassay data for employees at Joslyn Manufacturing. Internal doses from inhalation during uranium metal work are estimated using the data from the *Technical Basis Document: Site Profiles for Atomic Weapons Employers that Worked Uranium Metals* (DCAS 2011) for employment after July 31, 1948. Values listed in Table 7.8 of TBD-6000 are provided on a calendar day basis. In order to account for the intermittent work at Joslyn, these values were adjusted to a work day basis and combined with the number of work days listed in tables J-1. For rolling days, Table 7.8 rolling values were used and for machining days, Table 7.8 machining values were used. Machining values are higher so that value was used for days when both operations occurred.

For days when no uranium work occurred, inhalation of resuspended uranium contamination is still possible. To account for this, the contamination level was first calculated by assuming the airborne activity was depositing on horizontal surfaces for 720 hours (thirty 24 hour days) in accordance with the procedure in TBD-6000. This contamination was then assumed to resuspend with a resuspension rate of $1x10^{-5}$ m^{-1} to arrive at the airborne concentration from resuspension. The resuspended air

concentration was assumed to be present every work day but is inherently accounted for in the estimate during uranium work days.

The total inhaled activity from rolling, machining and resuspension was summed and divided by 365 days to arrive at an activity per calendar day value. The value varied by year due to variable uranium operations. The results are contained in table J.2.

Ingestion intakes were calculated in a manner similar to inhalation but using Table 7.9 of TBD-6000 instead of Table 7.8. Ingestion is proportional to contamination level and it is assumed those levels do not change between days of uranium work. Therefore, the operational ingestion values were also assigned for non-uranium work days. The ingestion intakes for Joslyn are included in table J.2.

Internal dose derived from both the inhalation and ingestion intakes are applied in IREP as a lognormal distribution with a GSD of 5. Because of the chemical and physical forms of uranium used at the site, only Type M or S solubility should be evaluated.

Table J.2 - Daily Uranium Intake Rates

Year	Inhalation (dpm/day)	Ingestion (dpm/day)
Aug. to Dec. 1948	3445	858
1949	1066	892
1950	2235	885
1951	1034	818
1952	1235	816

Thorium
Extruded thorium rods were ground on a centerless grinder on two occasions at Joslyn Manufacturing during 1946 and 1947. Although the centerless grinding operations could have created respirable particles, the work was performed wet for cooling purposes. Furthermore, as these operations were in the period that NIOSH finds it is not feasible to reconstruct internal exposures adequately, no internal dose is assigned from thorium operations.

J.5 Occupational External Dose
Uranium
Joslyn shaped billets of uranium into rods. TBD-6000 Table 6.1 contains dose rates from various shapes of uranium metal. The highest dose rates from any billets or rods listed in

the table are for long billets. Therefore, long billet dose rates were used for this dose estimate.

The photon dose rate at 1 foot from a long billet is 0.703 mrem/hr. Workers are assumed to be exposed to this dose rate for 10 hours on each day uranium metal was worked. On days with no uranium work, the estimated contamination levels from section J.4 were combined with the photon dose conversion factors from table 3.9 of TBD-6000.

The beta dose from uranium metal was estimated by multiplying the photon dose rate by a factor of 10 in accordance with TBD-6000. This was applied for each day of uranium metal work. For days without any uranium metal work, the estimated contamination level from section J.4 was multiplied by the beta dose rate conversion factor in Table 3.9 of TBD-6000.

An operator's hands and forearms may be considerable closer to the uranium metal than the rest of the body. Therefore a separate estimate for the hands and forearms of an operator is calculated using the contact dose rates of a uranium slab (TBD-6000 pg. 36) and the standard assumptions in TBD-6000 for Operators. This dose is included in table J.3.

The annual doses from both contamination and handling metal were prorated as applicable and summed in table J.3. These doses are applied in IREP as a lognormal distribution with a GSD of 5.

Table J.3 – Annual External Dose from Uranium

Year	Photon (mrem/yr)	Skin Whole Body (mrem/yr)	Skin Hands and Forearms (mrem/yr)
1943	134	2014	21449
1944	311	3839	50266
1945	388	4569	62873
1946	241	3175	38805
1947	94	1782	14738
1948	604	6626	98400
1949	24	1118	3278
1950	87	1716	13592
1951	23	1037	3278
1952	37	1170	5570

Penetrating doses should be assigned using the appropriate Deep Dose Equivalent Organ Dose Correction Factor found in the *External Dose Reconstruction Implementation Guideline* (NIOSH 2007). Non-penetrating dose should be assigned in accordance with the requirements contained in the *Technical Information Bulletin: Interpretation of Dosimetry Data for Assignment of Shallow Dose* (ORAU 2005).

Thorium

Joslyn did some very limited work with thorium metal. A total of 11 thorium metal rods were straightened and/or ground on two separate occasions (6 rods the first time and 5 rods the second time) in 1946 and 1947. There are indications that 14 uranium rods could be ground in 8 hours (Echo 1943, Simmons 1943) so it is likely the total grinding time for these 11 rods was less than a day. However, as a conservative estimate, the work will be assumed to take 5 work days (ORAU 2012, pg. 46) which is divided evenly between 1946 and 1947.

For external dose rates from thorium work, a computer program MCNP6 was used to model a thorium rod. The 6 rods for the first campaign were ground from 1.53 inch diameter to 1.4 inch (plus or minus 0.025 inches) diameter. The 5 rods from the second campaign were 1 and 7/8 inches in diameter and 50 inches long. The larger rods from the second campaign were used for the computer modeling of the thorium metal dose rates.

As another degree of bounding this estimate, the thorium metal was assumed to consist of thorium-232 in equilibrium with its decay products. This degree of equilibrium would take more than 20 years to achieve after the thorium ore was chemically separated and processed into metal.

The photon and beta dose rates at 1 foot and contact (1 cm) were determined. These dose rates were used to model the operator dose using the same assumptions as the uranium dose models in TBD-6000. These dose rates were applied for 2.5 days for 1946 and another 2.5 days for 1947. Both the photon and beta annual doses were calculated and included in table J.4. These doses are applied in IREP as a lognormal distribution with a GSD of 5.

Table J.4 – Annual External Dose from Thorium

Year	Photon (mrem/yr)	Skin Whole Body (mrem/yr)	Skin Hands and Forearms (mrem/yr)
1946	52	16	120
1947	52	16	120

J.6 Residual Contamination

Residual contamination potentially existed between operations with uranium at Joslyn. However, surveys showed the potential was low and so no residual contamination period was designated after 1952. The periods between operations is accounted for in a favorable manner in sections J.4 and J.5.

J.7 References

DCAS 2011, Battelle Memorial Institute, Battelle-TBD-6000, *Technical Basis Document: Site Profiles for Atomic Weapons Employers That Worked Uranium Metals, Rev 1*, June 17, 2011, SRDB Reference ID 101251.

DOE website, DOE Office of Environment, Health, Safety and Security, EEOICPA web site. https://hsspublic.energy.gov/search/facility/findfacility.aspx

Echo 1943, *Experimental Centerless Grinding of 14 Extruded Rods at Joslyn Manufacturing Company, Fort Wayne, Indiana*, correspondence to A. B. Greninger; Andrew Van Echo, Metallurgical Laboratory; September 7, 1943; SRDB 11036, PDF pp. 85-86.

NIOSH (2007) *External Dose Reconstruction Implementation Guideline, Rev 3*, OCAS-IG-001, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio, SRDB Reference ID 38864.

ORAU 2005, ORAUT (Oak Ridge Associated Universities Team), ORAUT-OTIB-0017, *Technical Information Bulletin: Interpretation of Dosimetry Data for Assignment of Shallow Dose, Rev 01*, October 11, 2005, SRDB Reference ID 19434.

ORAU 2011, ORAUT (Oak Ridge Associated Universities Team), ORAUT-OTIB-0006, *Technical Information Bulletin: Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures, Rev 04*, June 20, 2011, SRDB Reference ID 98147.

ORAU 2012, ORAUT (Oak Ridge Associated Universities Team), SEC Petition Evaluation Report for SEC-00200 Joslyn Manufacturing and Supply Company, December 3, 2012.

ORAU 2014, ORAUT (Oak Ridge Associated Universities Team), SEC Petition Evaluation Report Addendum for SEC-00200 Joslyn Manufacturing and Supply Company, January 14, 2012.

Simmons 1943, *Centerless Grinding Operations at Joslyn Manufacturing and Supply Company, Fort Wayne, Indiana, November 29 – December 16, 1943*, correspondence to A. B. Greninger; J. M. Simmons; December 31, 1943; SRDB 11036, PDF pp. 69-72.

Table J-5 – Uranium Rolling Days at Joslyn

Time Period	# of Rolling Days	Reference (SRDB Ref. ID)
3/13/1943	1	82362
6/29/1943	1	11036 p42, 33190 p66, and 33190 p244
Jan 3-14, 1944	1	11036 p53
May 3-6, 1944	4	11036 p216
May 9-June 24, 1944	7	33190 p67
June 1-5, 1944	5	17594 p4
June 19-20, 1944	2	118502 p2
7-Dec-44	1	118144 p4
December 11-28, 1944	13	34028 p 42
March-May, 1945	54	31145 p196
Unknown date, 1946	~10-20	90948 p8
October 28,1946	~1-2	93775 p6
November, 1946	~5-10	31145 p16
January, 1947	~5-10	90948 p2
August5-6, 1947	2	37411 p44, 126764 p5, 37374 p43, 16511 pp3 and 5, and 37390 p44
January 28-March 4, 1948	16	37587 p54, 36762 p 35, 36762 p38, 37586 p35, 129759 p9, 85872 p2, 11996 p129 and 37587 p23
April 3 - 5, 1948	3	16288 p5
May, 1948	26	59249 p7, 129474, and 11036 pdf p 19
June 4-18, 1948	15	16509, 129748 p10, and 11036 p177
July 9-11, 1948	3	118155 p2
July 27-30, 1948	4	115156 p2
1947-1950	~10 days	112574 p25 (see also 116843)
05/26/1949 - 05/27/1949	2	116843
February and July, 1950	2	36889 p109 and 36834 p131
04/26/1950 - 04/27/1950	2	116844
08/10/1950 - 08/11/1950	2	120484
8/4/1950	1	118159
5-Sep-50	1	28071 p2
10/24/1951	1	11036 pdf p. 23
01/08/1952 - 01/09/1952	2	9664
1/16/1952	1	9664

Table J-6 – Uranium Machining Days at Joslyn

Time Period	# of Rolling Days	Reference (SRDB Ref. ID)
6/29/1943	1	11036 p42, 33190 p66, and 33190 p244
9/7/1943	1	11036 p85
Nov. 29 – Dec 15, 1943	15	11036 pp59; 69; and 222-223
Unknown date, 1944	1	33190 p74
Jan 3-14, 1944	12	11036 p53
1/7/1944	1	11036 p135
February 23-26, 1944	4	11036 p130
May 3-6, 1944	4	11036 p216
June 1-5, 1944	5	17594 p4
March-May, 1945	54	31145 p196
Unknown date, 1946	~10-20	90948 p8
May, 1946	1	80171 p3
October 28,1946	1-2	93775 p6
November, 1946	~5-10	31145 p16
January, 1947	~5-10	90948 p2
August5-6, 1947	2	37411 p44, 126764 p5, 37374 p43, 16511 pp3 and 5, and 37390 p44
January 28-March 4, 1948	16	37587 p54, 36762 p 35, 36762 p38, 37586 p35, 129759 p9, 85872 p2, 11996 p129 and 37587 p23
April 3 - 5, 1948	3	16288 p5
April 10-17, 1948	8	37591 p164
May, 1948	26	59249 p7, 129474, and 11036 pdf p 19
June 4-18, 1948	15	16509, 129748 p10, and 11036 p177
July 9-11, 1948	3	118155 p2
July 27-30, 1948	4	115156 p2
8/5/1950	1	11036 p15
Aug 10-11, 1950	2	120484
24-Aug-51	1	11036 p23
7/16/1952	1	91923 p2
3/13/1943	1	82362
6/29/1943	1	11036 p42, 33190 p66, and 33190 p244