Responses to SCA-TR-SP2015-0050, Rev. 0, "Review of Site Profiles for Atomic Weapons Employers That Worked Uranium Metals: Appendix J-Joslyn"

Response Paper

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EXECUTIVE SUMMARY

Sanford Cohen & Associates (SC&A) was tasked by the Advisory Board on Radiation and Worker Health to conduct a review of the site profile for the Joslyn Manufacturing and Supply Company, Battelle-TBD-6000 Appendix J [National Institute for Occupational Safety and Health (NIOSH) 2014]. In SCA-TR-SP2015-0050, SC&A performed an independent evaluation of uranium processing days at Joslyn from March 1, 1943, to December 31, 1952 [SC&A 2015]. This response paper provides a reanalysis of the same uranium processing reports originally done for the Joslyn site profile.

NIOSH found several inconsistencies in the SC&A analysis that resulted in some differences in the number of uranium processing days. These inconsistencies include the production rate, number of shifts per day, and yield rates. NIOSH used the information compiled in SC&A [2015] and reassessed the assumptions made in Battelle-TBD-6000 Appendix J [NIOSH 2014].

SC&A [2015] also includes a review of the internal and external dose approaches in the site profile. This response paper does not respond to that analysis; it covers only the SC&A analysis of the number of uranium processing days.

INTRODUCTION

Section 1.2.1 of SC&A [2015] provides a year-by-year analysis of the various contracts Joslyn had with the Manhattan Engineer District and the U.S. Atomic Energy Commission (AEC) from March 1, 1943, to December 31, 1952. These contracts covered the rolling of uranium billets into rods and in some cases the machining of the rods via centerless grinding. The SC&A analysis states that the purpose of the assessment was to determine the "maximum likely number of days of uranium processing during each year" (p. 8). NIOSH believes some assumptions in the SC&A analysis do not result in likely scenarios but rather only provide maximizing estimates. The reanalysis in this response paper was done to perform a favorable and bounding, but realistic, estimate of the likely number of days of uranium processing during each year.

To do this, the information in the site profile [NIOSH 2014] and the Special Exposure Cohort (SEC) petition evaluation report [NIOSH 2012] was first used to determine a uniform assumption that could be used across all years to provide a more consistent set of assumptions when information is limited. This includes determining average billet and rod weight, average billet-to-rod yield, and production rates for rolling and machining. These default assumptions can then be used to estimate favorable production times when the documentation does not provide details.

ASSESSMENT OF DEFAULT ASSUMPTIONS

Average Billet and Rod Weight

Joslyn had several contracts with the Manhattan Engineer District between March 1, 1943, and December 31, 1952. Several of these contracts document individual or total numbers of billets and rods and their associated weights [Greninger 1943; Foote 1944; DuPont 1945; Smith 1947]. This information was used to calculate an average weight for billets and rods. The information from these sources resulted in a combined 636 billets and 1,028 rods with total weights of 157,436 lb (78.7 t) and 129,315 lb (64.7 t), respectively. This results in average weights of 248 lb per billet and 126 lb per rod.

Average Billet-to-Rod Yield

Most documentation associated with Joslyn production did not provide precalculated billet-to-rod yields. However, given the data on billet and rod weights, that data can be combined with the limited job-specific billet-to-rod yield results to calculate an overall average billet-to-rod yield. In 1949, a letter from the head of the Metallurgy and Control Division provided a table of observed rolling and machining yields [Hauff 1949]. This report not only provides billet-to-rod yields but also billet-to-slug, rod-to-slug, solid scrap, and turning yields for Joslyn, Simonds, and Vulcan. The Hauff report indicates that the billet-to-rod yields across all three rolling mills ranged from 93.5% to 99.2% and the billet-to-slug yield ranged from 54.3% to 71.3%. Given the large difference in these two yields, this knowledge was considered in determining if various contracts were for rolling only or potentially included machining when no information was provided on the type of work performed.

To determine average billet-to-rod yields, only the Joslyn data in Hauff [1949] was considered. In addition, the data in Hauff was combined with the billet and rod weight data [Greninger 1943; Foote 1944; DuPont 1945] to calculate an average Joslyn billet-to-rod yield. This analysis resulted in an average billet-to-rod yield value of 95% for Joslyn.

Production Rate for Rolling and Machining

The production rate for rolling and machining was based on several contracts in which billet and rod information and job length were provided. Jobs that likely occurred during a partial day were not considered in the average because it was not possible to determine the fraction of the day the rolling activities occurred. For example, in 1944 Joslyn processed 2.5 t of billets in likely less than a single day [Foote 1944]. The production rate for rolling was considered for various jobs, as follows:

- Klevin [1952, Appendix B]. Indicates that the plant was capable of performing 80 rollings per shift over 2 shifts per day. Given an average billet weight of about 0.124 t per billet, this results in a production rate of 19.8 t of billets per day.

- Smith [1947]. Processed 106 billets (69 G & 37 UM) for a total weight of 21,165 lb over the course of 2 days. This results in a production rate of 5.3 t of billets per day.

- Taussig [1948]. Processed 33 t of billets over the course of 5 days. This results in a production rate of 6.6 t of billets per day.

- Garrow [1959]. Processed 275 billets that averaged between 150 and 225 lb over the course of 2 days. This results in a production rate of 12.9 t of billets per day.

- DuPont [1945]. Processed 65.4 t of billets over the course of 7 days. This results in a production rate of 9.3 t of billets per day.

Based on these examples a favorable but realistic production rate of 5.3 t per day or about 43 billets per day was chosen based on the lower end of the production rates for billets listed above.

For machining production of rods, only two instances of processing time were identified:

- Klevin [1952, Appendix B]. Provides rates for machining, centerless grinding, grinding down burrs, and cutting on a Cut-O-Matic. The limiting task was machining the rod to the required outside diameter. The production rate for that task was six rods per shift during 2 shifts per day. This results in a production rate of 12 rods per day.

- Simmons [1943]. Processed 158 rods over the course of 10 days. This results in a production rate of 15.8 rods per day.

Based on these examples, a favorable but realistic production rate of 12 rods per day or about 0.75 t per day was chosen based on the lower end of the production rates for the rods listed above and on the average rod weight.

ASSESSMENT OF ANNUAL PRODUCTION

1943

The following jobs were identified that indicated potential work by Joslyn in 1943:

- Chipman [1943]. On March 13, 1943, three ingots (ingots and billets seem to be used interchangeably, therefore it was assumed they are the same) from Massachusetts Institute of Technology were processed. This represents 1 production day based on the date range.

- Greninger [1943]. On June 29, 1943, six billets were rolled. This represents 1 production day based on the date range.

- DeBlois [1946]. Joslyn used 32.3 t of uranium to produce 23.5 t of rods. That results in a yield of about 73%. This is more consistent with the yield associated with rolling and machining. Therefore, it was assumed both activities occurred. Assuming the Joslyn production rate, this results in an assumed rolling time of 7 days and machining time of 32 days for a total of 39 production days.

- Van Echo [1943a]. A September 1, 1943, report describes centerless grinding of extruded uranium rods at Joslyn. The report did not specify dates, duration, or quantity. However, the work on September 7, 1943, listed a single table of 14 rods and indicated that the work took 8 hours [Van Echo 1943b]. The report refers to three tables of rod information (those tables were not provided); therefore, it is assumed that this work took 3 times longer than the September 7, 1943, work (i.e., 24 hours). Assuming 8 hours per shift and 2 shifts per day, this work would take 2 production days.

- Van Echo [1943b]. On September 7, 1943, 14 rods were ground in 8 hours (i.e., 1 production day).

- Simmons [1943]. From November 29 to December 15, 1943, records indicate that work was performed 7 days a week, 16 hours per day (i.e., 2 shifts) with the exception of 1 day, November 30, when the machine was down). This results in 17 days of production.

Combining the above work results in a total of 61 production days. Because 1943 is a partial year, the number of nonproduction days was based on guidance in Battelle-TBD-6000 [NIOSH 2011]. For work before 1951, it was assumed that the site averaged 6 workdays per week. Therefore, from March 1 to December 31, 1943, there would be 252 potential workdays (assuming 2 weeks of vacation). Reducing this by the number of production days results in 191 nonproduction days for 1943.

1944

The following jobs were identified that indicated potential work by Joslyn in 1944:

- Frye [1946]. In late 1943, Joslyn started a contract with the University of Chicago to perform rolling services (p. 4). This contract was amended multiple times [Harrell 1944a,b,c,d, 1945] to increase the contract amount and time. There was no specific information on the amount of material or time of services. However, the final billed amount was $13,338 and the contract details indicate that the all inclusive billing rate was $12 per hour [Harrell 1944a,b]. Therefore, the billed amount of $13,338 represents about 1,112 hours of work. Assuming this work occurred during two 8-hour shifts per day (i.e. 16 work hours per day), the $13,338 billed represents about 70 days of work [Klevin 1952]. Although the contract extends over a long period, it is assumed all this work occurred in 1944.

- Simmons [1944a]. From January 3 to January 14, 1944, Joslyn performed rolling on 3 billets and machined 455 rods. This represents 12 production days based on the date range.

- Simmons [1944b , p. 130]. From February 23 to February 26, 1944, Joslyn performed cold drawing experiments on 20 rods. This represents 4 production days based on the date range.

- Greninger [1944]. On May 3 and 4, 1944, Joslyn performed rolling on 10 billets and machined 6 rods. This represents 2 production days based on the date range.

- DuPont [1945]. From May 9 to May 11, 1944, Joslyn performed rolling activities on 231 billets. This represents 3 production days based on the date range.

- Simmons [1944c], DuPont [1945]. On June 2, 1944, Joslyn performed experimental rolling on 23 new rolls. This represents 1 production day based on the date range.

- Simmons [1944d]. From June 19 to June 20, 1944, Joslyn performed experimental rolling on 2 bars. This represents 2 production days based on the date range.

- DuPont [1945]. From June 22 to June 24, 1944, Joslyn performed rolling on 252 billets. This represents 3 production days based on the date range.

- King [1945]. From December 11 to 12, 1944, Joslyn performed rolling on 40 billets, and from December 20 to 28, 1944, Joslyn performed rolling on 304 billets. This represents 11 production days based on the date range.

- Harrell [1944e]. In December of 1944, Joslyn performed work on what seems to be a second contract with the University of Chicago for rolling services. There was no specific information on the amount of material or time of services. The final billed amount was $11,801.83. The same billing rate from previous contracts of $12 per hour was assumed [Harrell 1944a,b]. Therefore, the billed amount of $11,801.83 represents about 983 hours of work. Assuming this work occurred during two 8-hour shifts per day (i.e. 16 work hours per day), the $11,802 billed represents about 62 days of work [Klevin 1952].

Combining the above work results in a total of 170 production days. The number of nonproduction days was based on guidance in Battelle-TBD-6000 [NIOSH 2011]. For work before 1951, it was assumed that the site averaged 6 workdays per week. Therefore, for 1944, there would be 300 potential workdays (assuming 2 weeks of vacation). Reducing this by the number of production days results in 130 nonproduction days for 1944.

1945

The following jobs were identified that indicated potential work by Joslyn in 1945:

- Bassett and Belmore [1945a,b], Belmore [1945a,b]. This contract indicated that 220 rods were produced at Joslyn. This amount is consistent with the values in Table 1 of Garrow [1961] on NRX rod fabrication which indicates 222 rods were produced from Mallinckrodt ingots. Assuming Joslyn's production rate, this results in an assumed rolling time of 3 days and machining time of 19 days for a total of 22 production days.

- Koenig [1945]. The letter indicated that a special requisition was "being investigated" for the processing of 12 t of rods. There is no indication this is the same work as the Belmore [1945a,b] work. Therefore, it is assumed this was a separate job. Assuming Joslyn's production rate, this results in an assumed rolling time of 3 days and machining time of 16 days for a total of 19 production days.

Combining the above work results in a total of 41 production days. The number of nonproduction days was based on guidance in Battelle-TBD-6000 [NIOSH 2011]. For work before 1951, it was assumed that the site averaged 6 workdays per week. Therefore, for 1945 there would be 300 potential workdays (assuming 2 weeks of vacation). Reducing this by the number of production days results in 259 nonproduction days for 1945.

1946

The following jobs were identified that indicated potential work by Joslyn in 1946:

- Chrestia [1947]. This monthly production report indicates that 11 t of rods were produced at Joslyn. This amount is consistent with the values in Table 1 of Garrow [1961] on NRX rod fabrication, which indicates 166 rods were produced from Mallinckrodt ingots (using the average rod weight, this represents about 10.4 t). Assuming Joslyn's production rate, this results in an assumed rolling time of 3 days. There was no indication that machining was performed.

- Belmore [1946], Koenig [1946], Beeler [1947]. These references indicate that Joslyn performed rolling for the British government. Beeler [1947] indicates that Joslyn received 450 billets (estimated to be 52 t) from the Electro Metallurgical Company and shipped 15.5 t of rods to Middlesex, 7.5 t of scrap to Metal Hydrides, and 7.5 t of D-2 to DuPont Recovery. The Beeler report is a cost analysis for the work performed for the British government. Given that 450 billets would result in more than 15 t of rods, it is assumed that the 15.5 t of rods were a separate rolling operation from the 450 billets. Therefore, using Joslyn's average yield, the 15.5 t of rods would have required an additional 16 t of billets. Assuming Joslyn's production rate, rolling 65 t of billets would require 13 rolling days. There was no indication that machining was performed.

- Cowen [1946]. Between October 28, 1946 and November 1, 1946, Joslyn produced 4,407.49 lb of rods. Therefore, using Joslyn's average yield this would have required 2.3 t of billets. Assuming Joslyn's production rate, rolling 2.3 t of billets would require 1 rolling day. There was no indication that machining was performed.

- Schumar and Swanson [1946]. Sometime before June 21, 1946, Joslyn performed straightening of approximately six composite rods. Assuming Joslyn's production rate, machining six rods would require 1 machining day.

Combining the above work results in a total of 18 production days. The number of nonproduction days was based on guidance in Battelle-TBD-6000 [NIOSH 2011]. For work before 1951, it was assumed that the site averaged 6 workdays per week. Therefore, for 1946, there would be 300 potential workdays (assuming 2 weeks of vacation). Reducing this by the number of production days results in 282 nonproduction days for 1946.

1947

The following jobs were identified that indicated potential work by Joslyn in 1947:

- Smith [1947]. On August 5 and 6, 1947, Joslyn performed rolling on 10 t of billets. This represents 2 production days based on the date range.

The above work results in a total of 2 production days. The number of nonproduction days was based on guidance in Battelle-TBD-6000 [NIOSH 2011]. For work before 1951, it was assumed that the site averaged 6 workdays per week. Therefore, for 1947, there would be 300 potential workdays (assuming 2 weeks of vacation). Reducing this by the number of production days results in 298 nonproduction days for 1947.

1948 (January 1 to July 31)

The approved SEC period is from March 1, 1943, to July 31, 1948 [NIOSH 2012]. Therefore, the analysis for 1948 was split in two. The following jobs were identified that indicated potential work by Joslyn from January 1 to July 31, 1948:

- Greninger [1948]. On February 6, 1948, Greninger indicates that Joslyn would be rolling all Hanford's billets. Four supplemental agreements for this work were issued [Blaeser 1948a,b,c,d, p. 172], resulting in the contract being extended to July 31 and 630 t of billets to be rolled. Assuming Joslyn's production rate, the rolling would require 120 rolling days. There was no indication that machining was performed.

- Taussig [1948]. On February 26, 1948, Taussig indicated that Joslyn agreed to roll approximately 35 t of billets from Mallinckrodt Chemical Works. Taussig estimated it would take Joslyn about 5 days to complete the work.

The above work results in a total of 125 production days from January 1 to July 31, 1948. The number of nonproduction days was based on guidance in Battelle-TBD-6000 [NIOSH 2011]. For work before 1951, it was assumed that the site averaged 6 workdays per week. Before August, there would be 174 potential workdays (assuming 1 week of vacation). Reducing this by the number of production days results in 49 nonproduction days before August.

1948 (August 1 to December 31)

The approved SEC period is from March 1, 1943, to July 31, 1948 [NIOSH 2012]. Therefore, the analysis for 1948 was split in two. The following jobs were identified that indicated potential work by Joslyn from August 1 to December 31, 1948:

- Macherey [1948]. Before August 4, 1948, Joslyn was tasked with the rolling of 7 billets. Assuming Joslyn's production rate, the rolling would require 1 rolling day. There was no indication that machining was performed.

The above work results in a total of 1 rolling production day from August 1 to December 31. The number of nonproduction days was based on guidance in Battelle-TBD-6000 [NIOSH 2011]. For work before 1951, it was assumed that the site averaged 6 workdays per week. From August 1 to December 31, 1948, there would be 126 potential workdays (assuming 1 week of vacation). Reducing this by the number of production days results in 125 nonproduction days before August.

1949

The following jobs were identified that indicated potential work by Joslyn in 1949:

- Garrow [1959]. The August report on batch 3 for the NRX Reactor indicates that between May 26, 1948, and May 27, 1949, Joslyn performed rolling on 275 billets and produced 244 rods that were finished via centerless grinding. This amount is consistent with the values in Table 1 of Garrow [1961] on NRX rod fabrication, which indicates 244 rods were produced from Mallinckrodt ingots. Assuming Joslyn's production rate, this results in an assumed rolling time of 2 days and a machining time of 21 days.

The above work results in a total of 2 rolling production days and 21 machining production days. The number of nonproduction days was based on guidance in Battelle-TBD-6000 [NIOSH 2011]. For work before 1951, it was assumed that the site averaged 6 workdays per week. Therefore, for 1949, there would be 300 potential workdays (assuming 2 weeks of vacation). Reducing this by the number of production days results in 277 nonproduction days for 1949.

1950

The following jobs were identified that indicated potential work by Joslyn in 1950:

- Belmore [1950]. A June 23, 1950, letter requested Joslyn to perform rolling on 305 billets. The resulting rods were to be straightened and finished via centerless grinding. Assuming some nominal losses, this amount would be consistent with the values in Table 1 of Garrow [1961] on NRX rod fabrication, which indicates 270 rods were produced from Mallinckrodt ingots. Assuming Joslyn's production rate, this results in an assumed rolling time of 8 days and a machining time of 26 days.

- Freitag [1950]. On July 31, 1950, a request was made to have 5,500 lb of rolled uranium rods shipped to Joslyn. This would represent about 44 rods. Assuming Joslyn's production rate, this results in an assumed machining time of 4 days.

- Harris [1950]. This letter indicates that three uranium jobs were performed at Joslyn in the month of August. No additional information was provided on the details of the three jobs. Table 1 of Garrow [1961] on NRX rod fabrication indicates that an additional job producing 10 rods from Mallinckrodt ingots was performed in 1950. It is assumed that this represents the third job in the Harris letter. Given the small size of this job, it is also likely this was what Stroke [1950] was referring to in his September 5 memorandum discussing an experiment about the rolling of uranium rods at Joslyn. Assuming Joslyn's production rate, this results in an assumed rolling time of 1 day and a machining time of 1 day.

- Braiden and Gustavsen [1951]. This letter indicated that Joslyn shipped 6,621 kg (7.3 t) of uranium rods and 234 kg (0.3 t) of billets to the AEC Lake Ontario Office between January 1 and October 31, 1950. Assuming an average rod weight, this would represent about 116 rods. Assuming Joslyn's production rate, this results in an assumed rolling time of 2 days and a machining time of 10 days.

The above work results in a total of 11 rolling production days and 41 machining production days. The number of nonproduction days was based on guidance in Battelle-TBD-6000 [NIOSH 2011]. For work before 1951, it was assumed that the site averaged 6 workdays per week. Therefore, for 1950, there would be 300 potential workdays (assuming 2 weeks of vacation). Reducing this by the number of production days results in 248 nonproduction days for 1950.

1951

The following jobs were identified that indicated potential work by Joslyn in 1951:

- General Electric Company [1951]. This monthly report for July 1951 indicated that 4 rods were rolled at Joslyn [p. 109]. Assuming Joslyn's production rate, this results in an assumed rolling time of 1 day and a machining time of 1 day.

The above work results in a total of 1 rolling production day and 1 machining production day. The number of nonproduction days was based on guidance in Battelle-TBD-6000 [NIOSH 2011]. For 1951 to 1955, it was assumed that the site averaged 5.5 workdays per week (44 hours). Therefore, for 1951, there would be 275 potential workdays (assuming 2 weeks of vacation). Reducing this by the number of production days results in 273 nonproduction days for 1951.

1952

The following jobs were identified that indicated potential work by Joslyn in 1952:

- Klevin [1952, Appendix B]. This 1952 report provided air dust data for 3 production days at Joslyn on January 8, 16, and 18. The sample description for the January 8 air samples seems to represent rolling activities, whereas the sample descriptions for the January 16 and 18 air samples seem to represent machining activities. Therefore, 1 rolling day and 2 machining days were assumed.

- Smith [1952a]. On January 23, 1952, a request was made to have 4 rods shipped to Joslyn. Assuming Joslyn's production rate, this results in an assumed machining time of 1 day.

- Smith [1952b, p. 231]. On April 11, 1952, a request was made to have 15 rods shipped to Joslyn. Assuming Joslyn's production rate, this results in an assumed machining time of 2 days.

- Dunlap [1952]. This letter indicates that Joslyn was requested to assist in the preparation of three differently sized experimental rods. It was assumed that each diameter was machined on a different day. Therefore, 3 machining days were assumed.

The above work results in a total of 1 rolling production day and 8 machining production days. The number of nonproduction days was based on guidance in Battelle-TBD-6000 [NIOSH 2011]. For 1951 to 1955, it was assumed that the site averaged 5.5 workdays per week (44 hours). Therefore, for 1951, there would be 275 potential workdays (assuming 2 weeks of vacation). Reducing this by the number of production days results in 268 nonproduction days for 1952.

SUMMARY

Table 1 provides a summary of NIOSH's reassessment of the favorable, but realistic, number of rolling and machining workdays based on the information in the Joslyn site profile [NIOSH 2014], the SEC petition evaluation report [NIOSH 2012], and the SC&A review [SC&A 2015].

Table 1. NIOSH estimate of the number of rolling and machining workdays.

Year	Operational days[a]	Rolling days	Machining days	Nonoperational days	Total workdays
1943	61	n/a[b]	n/a	191	252
1944	170	n/a	n/a	130	300
1945	41	n/a	n/a	259	300
1946	18	n/a	n/a	282	300
1947	2	n/a	n/a	298	300
01/01–07/31/1948	125	n/a	n/a	49	174
08/01–12/31/1948	n/a	1	0	125	126
1949	n/a	2	21	277	300
1950	n/a	11	41	248	300
1951	n/a	1	1	273	275
1952	n/a	1	8	266	275

a. For the SEC period from March 1, 1943, to July 31, 1948, rolling and machining days were combined.
b. n/a = not applicable.

Table 2 provides the SC&A assessment of maximizing rolling and machining workdays.

Table 2. SC&A estimate of the number of rolling and machining workdays.

Year	Operational days[a]	Rolling days	Machining days	Nonoperational days	Total workdays
1943	32	n/a[b]	n/a	182	214
1944	201	n/a	n/a	51	252
1945	63	n/a	n/a	187	250
1946	86	n/a	n/a	164	250
1947	6	n/a	n/a	244	250
01/01–07/31/1948	110	n/a	n/a	36	146
08/01–12/31/1948	n/a	1	0	103	104
1949	n/a	2	5	243	250
1950	n/a	6	10	234	250
1951	n/a	0	2	248	250
1952	n/a	0	7	243	250

a. For the SEC period from March 1, 1943, to July 31, 1948, rolling and machining days were combined.
b. n/a = not applicable.

The one year that shows a significant difference between the SC&A and NIOSH estimates is 1944. The main reason for this difference is due to the SC&A assumption that the estimate of the number of workdays (based on the billing amount for the two University of Chicago contracts) was performed by one person. NIOSH found this to be an unrealistic assumption and used the description in Appendix B of Klevin [1952] to provide a more realistic minimum number of workers that would have been associated with the billed amount, resulting in a sizable reduction in the number of workdays.

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