Joslyn Manufacturing and Supply Co. Update

Alek Kranbuhl, M.S.

Health Physicist

TBD-6000 Work Group

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Objectives

- Operations at Joslyn
- Review of open Findings
- NIOSH Assessment of Rolling Days
- NIOSH plan to address Findings

Operations at Joslyn

Joslyn Manufacturing and Supply Co. Overview:

- Located in Ft. Wayne, Indiana
- Performed a wide variety of metalworking operations for MED and AEC during covered period from March 1, 1943, to December 31, 1952
- Vital in the development of procedures for metalworking of natural uranium, including rolling and machining rods
- Joslyn produced large numbers of uranium rods for use in Hanford reactors from billets provided by MED

SC&A Review

TBD-6000 App. J Status:

- TBD-6000 Appendix J – Joslyn Approved Oct. 7, 2014
- March 24, 2015, SC&A tasked with review of the document
- May 12, 2015, SC&A issued *Review of "Site Profile for Atomic Weapons Employers That Worked Uranium Metals: Appendix J – Joslyn"* (SCA-TR-SP2015-0050, Revision 0)
- Report details 7 findings and 2 observations

Findings 1-3:

- Finding 1: Underestimated Uranium Workdays
  - The number of uranium working days at the site was underestimated due to only using confirmed rolling operations from records in the SRDB. The site's contracts and billing with the U of C were not evaluated.
- Finding 2: Underestimated Inhaled Intakes
- Finding 3: Underestimated Photon and Electron Dose Rates from Contaminated Floor from Putzier Effect and Number of Rolling Days

Findings 4-7:

- Finding 4: Underestimated Doses from External Exposure to Penetrating Radiation from Uranium
- Finding 5: Exposures Improperly Combined with Personal Dose Equivalents $H_p(10)$
- Finding 6: Underestimated Doses to Skin from Nonpenetrating Radiation from Uranium
- Finding 7: Underestimated External Exposure to Thorium
  - Due to incorrect geometry in MCNP analysis

Summary of Observations:

- Observation 1: Insufficient information for review that is publicly available or cited
- Observation 2: Inconsistencies in General Assumptions- differences between TBD-6000 and Appendix – J

NIOSH Assessment of Rolling Days

Rolling Days Assessment:

- On July 19, 2023, NIOSH issued a white paper to address the number of operational days at the site
- Default assumptions had to be used in cases where information was lacking for:
  - Average Billet and Rod Weight
  - Average Billet-to-Rod Yield
  - Production Rate for Rolling and Machining Operations

Average Billet and Rod Weight:

- Joslyn had several contracts with MED between March 1, 1943, and December 31, 1952.
- Some contracts detail number of billets delivered to the site and number of rods produced. [Greninger 1943; Foote 1944; DuPont 1945; Smith 1947]
- Combined information totals 636 billets and 1,028 rods with total weights of 157,436 lbs. (78.7 t) and 129,315 lbs. (64.7 t).
- Average weight of 248 lbs. per billet and 126 lbs. per rod.

Average Billet-to-Rod Yield:

- 1949 Letter from the head of the Metallurgy and Control Division [Hauff 1949] provides a table of observed rolling and machining yields for billet-to-rod, billet-to-slug, rod-to-slug, solid scrap, and turning yields for Joslyn, Simonds, and Vulcan.
- Average billet-to-rod yield across the three sites ranges from 93.5% to 99.2%; billet-to-slug yield from 54.3% to 71.3%.
- This information was combined with the billet and rod weight data to produce an average billet-to-rod yield of 95% for Joslyn.

Production Rate for Rolling and Machining Operations:

- NIOSH determined production rates by evaluating several contracts which contained both billet and rod information and job length.
- Rolling rates varied from 5.3 t/day to 19.8 t/day.
- Machining rates were only available in two documents- [Simmons, 1943; Klevin, 1952] , which gave a rate of 15.8 rods per day and 12 rods per day, respectively.
- Claimant-favorable but realistic rates of 5.3 t/day and 12 rods (0.75t)/day for rolling and machining, respectively, were used.

Rolling Days Summary:

Year	Operational Days[a]	Rolling Days	Machining Days	Non-Operational Days	Total Workdays
1943	61	n/a	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]Rolling and machining days were combined during the SEC Period.

Year-By-Year Comparison Between SC&A and NIOSH:

Year	Operation Type	NIOSH Estimate	SC&A Estimate	Difference (NIOSH-SC&A)
1943	Combined	61	32	+29
1944	Combined	170	201	-41
1945	Combined	41	63	-22
1946	Combined	18	86	-68
1947	Combined	2	6	-4
01/01-07/31/1948	Combined	125	110	+15
08/01-12/31/1948	Rolling	1	1	0
1949	Rolling	2	2	0
1949	Machining	21	5	+16
1950	Rolling	11	6	+5
1950	Machining	41	10	+31
1951	Rolling	1	0	+1
1951	Machining	1	2	-1
1952	Rolling	1	0	+1
1952	Machining	8	7	+1

Variability in 1944 & 1946

- 1944: Difference of 41 days is primarily due to NIOSH's assumption that Joslyn operated on a two shift, 16-hour day schedule, SC&A assumed a single, ten-hour shift.
- 1946: Difference of 68 operational is due to SC&A's assumption that it would take Joslyn 62 days to roll 12 tons of rods (0.1935t/day). NIOSH estimate uses a default rate of 5.3t per day.

Workdays Calculation for U of C Contract

NIOSH:

$$Operational\ Days = \frac{\$13338\ (total\ billed\ amount)}{\frac{\$12}{hr}\ (hourly\ billing\ rate)}\ x\ \frac{1\ workday}{16\ hours}$$

$$= 69.4\ days$$

SC&A:

$$Operational\ Days = \frac{\$13388\ (total\ billed\ amount)}{\frac{\$12}{hr}\ (hourly\ billing\ rate)}\ x\ \frac{1\ workday}{10\ hours}$$

$$= 111.56\ days$$

Ensuring Claimant-Favorability

- This estimate likely exceeds the true number of operational days, from the information we evaluated because:
  - Use of low-end production values
  - Likely date overlap between documented operations and U of C contract
  - Rolling and machining operations were considered to take place sequentially, when they were likely performed concurrently

Path Forward

Outstanding Issues

- With this estimate of operational days, intakes and external exposure can be assigned using the methods prescribed in TBD-6000 for Findings 1-4, and 6.
- Finding 5 is an error resulting from combining calculated exposures in milliroentgens with doses in millirem. This requires a conversion to organ dose.
- MCNP runs related to Finding 7 are being evaluated.

Sample External Dose Calculation:

$$D_{Ext} = \sum [DR_{Rod,1ft} \times (h_{wd} \times d_{op})] + [DCF_{\frac{\alpha}{\gamma}} \times \overline{c} \times (h_{wd} \times d_{non-op})]$$

Where:

$DR_{Rod, 1ft}$ = dose rate from U rod @ 1 ft. (0.703 mrem/hr, TBD-6000 Table 6.1)

h_{wd} = hours in the workday

$d_{op/non-op}$= number of days in an operational (nonoperational) period

$DCF_{\alpha/\gamma}$ = conversion factor from alpha contamination to gamma dose rate (3.94E-10 [mR/hr]/[dpm_{α}/m^2], TBD-6000 Table 3.10)

$\overline{c}$ = contamination level (dpm/m2), derived from [A] (dpm/m3) x 1944 m (settling velocity x seconds/30d)

Sample Intake Calculation:

$$I = \frac{d_w \times \sum\left([A]_{op} \times R_b \times \left(h_{wd} \times d_{op}\right)\right) + \left(\bar{c} \times RF \times R_b \times \left(h_{wd} \times d_{non-op}\right)\right)}{365\ days}$$

Where:

I = Intake (dpm)

d_w= number of days the EE was employed in the year

$[A]_{op}$ = airborne concentration for a given operation, TBD-6000 Table 7.8

R_b = respiratory rate (1.2 m^3/hr)

$\bar{c}$ = contamination level (dpm/m^2), derived from [A] (dpm/m^3) x 1944 m

(settling velocity x seconds/30d)

RF = resuspension rate

Finding 3 & 6: Putzier Effect

- Proposed language change for TBD-6000 to describe Putzier Effect is incorporated in Rev. 1, Section 3.3.1
- Appendix J, Section J.5: “The beta dose from uranium metal was estimated by multiplying the photon dose rate by a factor of 10 in accordance with TBD-6000.”
- According to the BRS, issue was resolved with SCPR on 1/6/2017

References

- DuPont [1945]. The metal fabrication program for the Clinton Engineer Works and the Hanford Engineer Works including the dummy slug program and the unbonded slug program – Project 1553. Wilmington, DE: E. I. du Pont de Nemours and Company. August. [SRDB Ref ID: 33190]
- Foote F [1944]. Preparation of slugs and inspection procedure alpha rolled slugs - September 15,1944. Memorandum to A.B. Greninger. Metallurgical Laboratory, Chicago, IL: University of Chicago. November 27. [SRDB Ref ID: 101152]
- Greninger AB [1944]. Rolling and grinding of special steel. Letter to L. Frey, Joslyn Manufacturing and Supply Company. Metallurgical Laboratory, Chicago, IL: University of Chicago. April 28. [SRDB Ref ID: 196565]

Additional References

- Hauff TW [1949]. Rolled uranium - fabrication yields. Letter to F.C. Schlemmer, U.S. Atomic Energy Commission, Hanford Operations Office. Hanford Works, Richland, WA: General Electric Company. February 22. [SRDB Ref ID: 71035]
- SC&A [2015]. SC&A Draft: Review of “Site profiles for atomic weapons employers that worked uranium metals: appendix J-Joslyn.” Vienna, VA: S. Cohen and Associates. SCA-TR-SP2015-0050 Rev. 0, May 12. [SRDB Ref ID: 195945]
- Smith EA [1947]. Uranium rolling at Ft. Wayne, Ind. - August 5-6, 1947. Memorandum to T.W. Hauff. Hanford Engineer Works, Richland, WA: General Electric Company. HEW-7495, September 9. [SRDB Ref ID: 16511]

For more information, contact CDC
1-800-CDC-INFO (232-4636)
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