Additional Information in Response to SEC-00247 ER Review Finding #1

Response Paper

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BACKGROUND

The TBD-6000 Work Group (WG) met on February 4, 2020 to discuss the "SC&A Review of the SEC Petition Evaluation Report for Petition SEC-00247: Superior Steel Co." and the NIOSH responses to that review, which were provided in the Superior Steel Co. Special Exposure Cohort (SEC-00247) Issues Matrix dated October 24, 2019 [NIOSH 2019; SC&A 2019]. During this discussion, the WG requested additional information in support of Finding #1: Failure to justify process similarities that support the use of the Vulcan Crucible billing rate.

Finding #1 discussed the lack of justification with respect to the Board's five surrogate data criteria for using a surrogate billing rate to determine the number of uranium rolling hours for Superior Steel Co. [SC&A 2019]. The SEC-00247 ER proposed to use a surrogate billing rate, from Vulcan Crucible, along with the Superior Steel Co. annual payments to determine the number of uranium rolling hours to assume per year [NIOSH 2018]. The surrogate billing approach to calculate rolling hours is used in the Superior Steel Co. Site Profile to justify the choice of 800 rolling hours per year as bounding. The current Site Profile approach arbitrarily assumes 8 hours of rolling per day, 2 uranium rolling days per week, and 50 weeks per year, to determine the 800 uranium rolling hours per year [ORAUT 2006, PDF p. 10]. NIOSH [2018] proposed to use the actual surrogate billing rate approach rather than the current arbitrary approach, because it provides a more reasonable and justified estimate of the number of rolling hours.

A surrogate billing rate was required because the original Superior Steel Co. contract (AT(30-1)-1412) was destroyed and no contract-specific information with regards to billing rates or the amount of contracted time for uranium rolling was available at the time of the ER. However, the annual and total contract payments for Superior Steel Co. and general information regarding the contract were available [SROO 1952-1957]. The number of uranium rolling hours calculated using the surrogate billing rate approach proposed in the ER resulted in a decrease to 500 uranium rolling hours per year [NIOSH 2018].

During the research in response to Finding #1, NIOSH found Modification #5 to the Superior Steel Co. contract [SROO 1955]. This contract modification Article V provided the billing rate effective on July 1, 1955: $1.01 per pound of uranium (weight at receipt) for metallurgical or machining and other services rendered in accordance with Article II, paragraph 1 [SROO 1955, p. 8]. Payment rates for additional services that may be requested were also detailed as: (a) $0.030 per pound for inspection of flats after pickling before shipment to heat treating facility (b) $0.050 per pound for inspection of flats before planing, and (c) $0.055 per pound for beta treating slabs [SROO 1955, p. 9].

In order to use the Superior Steel Co. billing rate (quoted in per pound received) to determine the number of uranium rolling hours per year, additional assumptions regarding the typical weight per uranium slab and typical number of slabs processed in a year or the typical weight processed in a year are required to calculate the number of uranium rolling hours per year. Given the limited information available and variability in weights and number of slabs processed, it was proposed by NIOSH to continue using the surrogate billing rate to determine the number of rolling hours [NIOSH 2019].

On January 14, 2020, SC&A issued responses to the NIOSH October 2019 responses [NIOSH 2019; SC&A 2020]. SC&A's response for Finding 1 provided an approach using the Superior Steel Co. billing rate ($1.01 per pound uranium received for rolling) and the agreed upon assumption of 10 milling hours per day using the following formula:

$$\frac{\left[\textit{Annual Payment}\left(\frac{\$}{year}\right)\right]/\left[1.01\left(\frac{\$}{pound}\right)\right]}{\left[\textit{Slab Weight}\left(\frac{pound}{slab}\right)\right]\times\left[\textit{Number of Slabs}\left(\frac{slab}{day}\right)\right]}\times\left[10\left(\frac{hour}{day}\right)\right]=\left[\textit{Rolling Time}\left(\frac{hour}{year}\right)\right]$$

with the highest annual payment to Superior Steel Co. (FY 1956) less the estimated Schedule A reimbursable expenses ($138,246), the lowest slab weight (216 pounds), and an assumption of 25 slabs processed per day [SC&A 2020; SROO 1952-1957, 1955]. This resulted in 253 uranium rolling hours per year, which SC&A believed was a more reasonable, yet bounding assumption than the 500 uranium rolling hours per year calculated using the surrogate billing rate [SC&A 2020].

The discussion during the February 4, 2020 WG meeting focused on whether the Superior Steel Co. billing rate should be used despite the variability in these additional input values. The WG requested additional information regarding the available slab weight information and the number of slabs processed in order to better understand the variability in these input values. This document will review the available information for number of uranium slabs rolled per day and weight of uranium slabs and propose a better method of estimation that takes the input value variability into account.

AVAILABLE SUPERIOR STEEL CO INFORMATION

Number of Slabs Rolled per Day

There is no specific reference that discusses Superior Steel Co. uranium rolling capacity or output per day. However, there is information available in six Site Research Database (SRDB) documents about the number of slabs rolled per day. These documents include Health and Safety Laboratory Reports (HASL) from the air monitoring campaigns [AEC 1955a,b; Klevin 1953a,b], a Savannah River Site Technical Report discussing the February 22 and 23, 1954 rolling at Superior Steel Co. [E.I. du Pont de Nemours & Co. 1954], and a letter from Superior Steel Co. to the Oak Ridge Operations Office discussing rolling data from the August 3, 1954 rolling [Boyer 1954]. Information provided in these documents is presented in Table 1.

The minimum average number of uranium slabs rolled in a day is 10, while the maximum is 50. The weighted average (total slabs rolled divided by total days rolling) for these numbers is 28.14 slabs rolled per day.

Table 1. Available information on the number of slabs rolled per day for Superior Steel Co. including SRDB references.

SRDB Ref ID	Date(s) of Rolling	Number of Days Rolling	Number of Slabs Rolled	Average Number of Slabs Rolled per Day
6898	May 3, 1953	1	10	10
6899	August 3, 1953	1	23	23
15189	February 22 and 23, 1954	2	52	26
132695	August 3, 1954	1	50	50
6877	May 9, 1955	1	32	32
6888	September 19, 1955	1	30	30

Weight of Slabs Received

There is no specific reference that discusses the typical weight of slabs received by Superior Steel Co., nor is there slab weight information in the references given above for the number of slabs rolled per day. However, there is slab weight information available in customs and shipping paperwork for slabs being sent from Canada to Superior Steel Co. [U.S. Customs Documents 1955a,b,c, 1956a,b,c,d,e, 1957], which include total box weights and number of slabs per box; as well as, slab weight information available in one Fernald document discussing a Superior Steel Co. purchase order [Karl and Wunder 1953], which includes total shippable metal weight and number of slabs. The shipping and customs paperwork can't be directly related to specific dates of uranium rolling, but the shipping date information does give an indication of the time-frame a rolling may have taken place. Information provided in these documents is given in Table 2.

The minimum average weight per slab received is 198 pounds, while the maximum is 533 pounds. The weighted average (total slab weight divided by total number of slabs) for these numbers is 253 pounds.

Table 2. Slab weight information and references.

SRDB Ref ID	Date[a]	Number of Slabs	Total Weight at Receipt (lb)	Avg. Slab Weight at Receipt (lb)
101428	January 24, 1955	64	13815	216
101407	May 19, 1955	12	2379	198
101407	May 19, 1955	11	2277	207
101407	May 19, 1955	4	901	225
101407	May 19, 1955	11	2489	226
101407	May 19, 1955	11	2524	229
101407	May 19, 1955	4	924	231
101407	May 19, 1955	4	926	232
101407	May 19, 1955	11	2547	232
101407	May 19, 1955	14	3249	232
101407	May 19, 1955	4	929	232
101407	May 19, 1955	10	2554	255
101416	January 23, 1956	12	2660	222
101416	January 23, 1956	12	2669	222
101416	January 23, 1956	12	2788	232
101416	January 23, 1956	13	3048	234
101416	January 23, 1956	12	2823	235
101416	January 23, 1956	12	2851	238
101416	January 23, 1956	12	2889	241
101416	January 23, 1956	13	3137	241
101435	January 25, 1956	8	1842	230
101435	January 25, 1956	8	1846	231
101435	January 25, 1956	9	2080	231
101435	January 25, 1956	9	2104	234
101435	January 25, 1956	9	2115	235
101435	January 25, 1956	7	1664	238
101438	March 2, 1956	9	2900	322
101438	March 2, 1956	9	2930	326
101438	March 2, 1956	9	3264	363
101438	March 2, 1956	9	3286	365
101438	March 2, 1956	9	3290	366
101395 and 101399	April 30, 1956	10	2435	244
101395 and 101399	April 30, 1956	10	2430	243
101395 and 101399	April 30, 1956	10	2391	239

SRDB Ref ID	Date[a]	Number of Slabs	Total Weight at Receipt (lb)	Avg. Slab Weight at Receipt (lb)
101395 and 101399	April 30, 1956	9	2157	240
101395 and 101399	April 30, 1956	8	1912	239
101395 and 101399	April 30, 1956	7	1666	238
101395 and 101399	April 30, 1956	10	2430	243
101395 and 101399	April 30, 1956	9	2181	242
101395 and 101399	April 30, 1956	10	2393	239
101395 and 101399	April 30, 1956	9	2152	239
101395 and 101399	April 30, 1956	9	2146	238
101395 and 101399	April 30, 1956	10	2385	239
101393	July 27, 1956	9	1966	218
101393	July 27, 1956	10	2224	222
101393	July 27, 1956	9	2138	238
101426	June 10, 1957	10	2124	212
101426	June 10, 1957	10	2127	213
101426	June 10, 1957	10	2132	213
101426	June 10, 1957	10	2138	214
101426	June 10, 1957	10	2142	214
101426	June 10, 1957	10	2145	215
101426	June 10, 1957	10	2174	217
101426	June 10, 1957	10	2239	224
101426	June 10, 1957	10	4433	443
29522 (p. 4 and 8)	N/A	24	12800	533

a.- For customs and shipping paperwork with multiple forms and dates, the date listed is the customs release date or the entry date on U.S. customs form, if release date isn't available.

DISCUSSION

There are limited references available that discuss the number of uranium slabs rolled during a day or campaign. As discussed above a majority of the references are the HASL air monitoring reports, which list the number of uranium slabs that were rolled during the air monitoring. The other two reports that are referenced in Table 1 are technical reports on rolling results, like thicknesses, shearing, etc., but include number of slabs processed. This information is used to calculate an average number of slabs rolled per day.

There are limited references available that discuss the weight of the uranium slabs received by Superior Steel Co. Most of the references that feed Table 2 are customs and shipping paperwork for slabs that were shipped to Superior Steel Co. from Atlas Steels, Ltd. in Canada. This paperwork generally gives the number of slabs per box and a net weight per box that can be used to calculate an average slab weight. The other document with weight information is a Fernald Purchase Order that discusses shippable uranium metal weights. Neither of these sources of information are considered a direct source of slab weight at receipt by Superior Steel Co., because these weights aren't tied to Superior Steel Co. payments or specific AEC contract work. These are the only sources of information available at this time, but are site-specific and therefore, the best references from which we can make assumptions.

Using the formula above and the values from Tables 1 and 2, the rolling time would be maximized by using the maximum annual payment ($138,246), the minimum slab weight (198 pounds), and the minimum number of slabs per day (10). These input values result in a maximum rolling time of 691 hours per year. Conversely, the rolling time would be minimized by using the minimum annual payment ($38,677), the maximum slab weight (533 pounds), and the maximum number of slabs per day (50). These input values result in a minimum rolling time of 14 hours per year. Based on the high variability in available data for input values, the resulting rolling time estimates can range from 14 hours to 691 hours per year. Because of the large uncertainty in the resulting rolling time estimates, it is much more appropriate to look at the distribution of rolling time estimates, given various combinations of possible input values, than to come up with a single estimate of rolling time from single input values.

To determine the distribution of rolling times, we can use a simulation that incorporates the Superior Steel Co. data. There are four known annual payments ($46,294, $38,677, $138,246, and $54,632), so we can randomly sample from those four values. Given the small amount of data in Table 1, we use a triangular distribution with the lower limit equal to the minimum number of slabs rolled (10), the upper limit equal to the maximum number of slabs rolled (50), and the mode equal to the weighted average (28.14). Table 2 provides 56 average slab weights, which represent 606 total slabs. With 56 values, we can fit a lognormal distribution to the average slab weights (Figure 1).

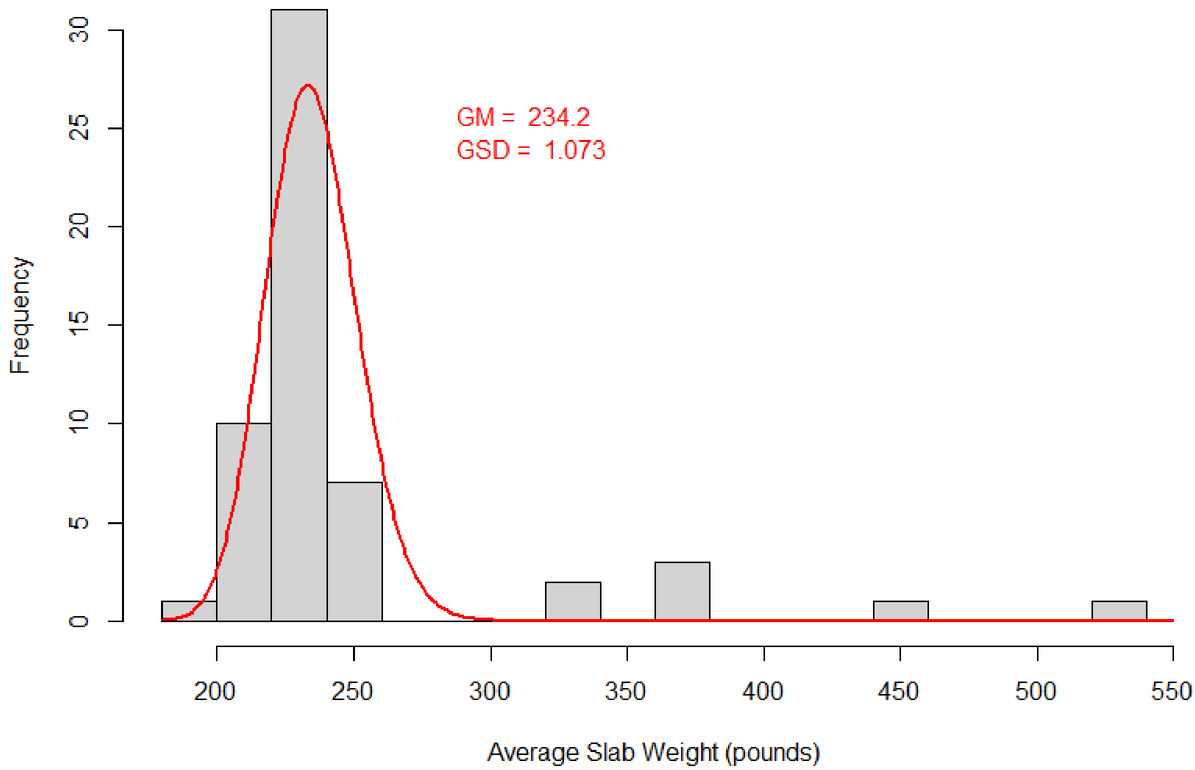

Figure 1. Histogram[1] displaying the distribution of 56 average slab weight values, with lognormal distribution overlaid as a red curve.

Randomly sampling from the four known annual payments, randomly sampling from the triangular distribution for number of slabs, and randomly sampling from the lognormal distribution for slab weights, the rolling time estimates from one million iterations are given in Figure 2.

[1] A histogram is one way to display univariate data that relies on binning the values. For example, the tallest bar in this plot represents average slab weights more than 220 pounds but less than or equal to 240 pounds. There 31 such average slab weights, which is why the height of the bar corresponds to a frequency of 31.

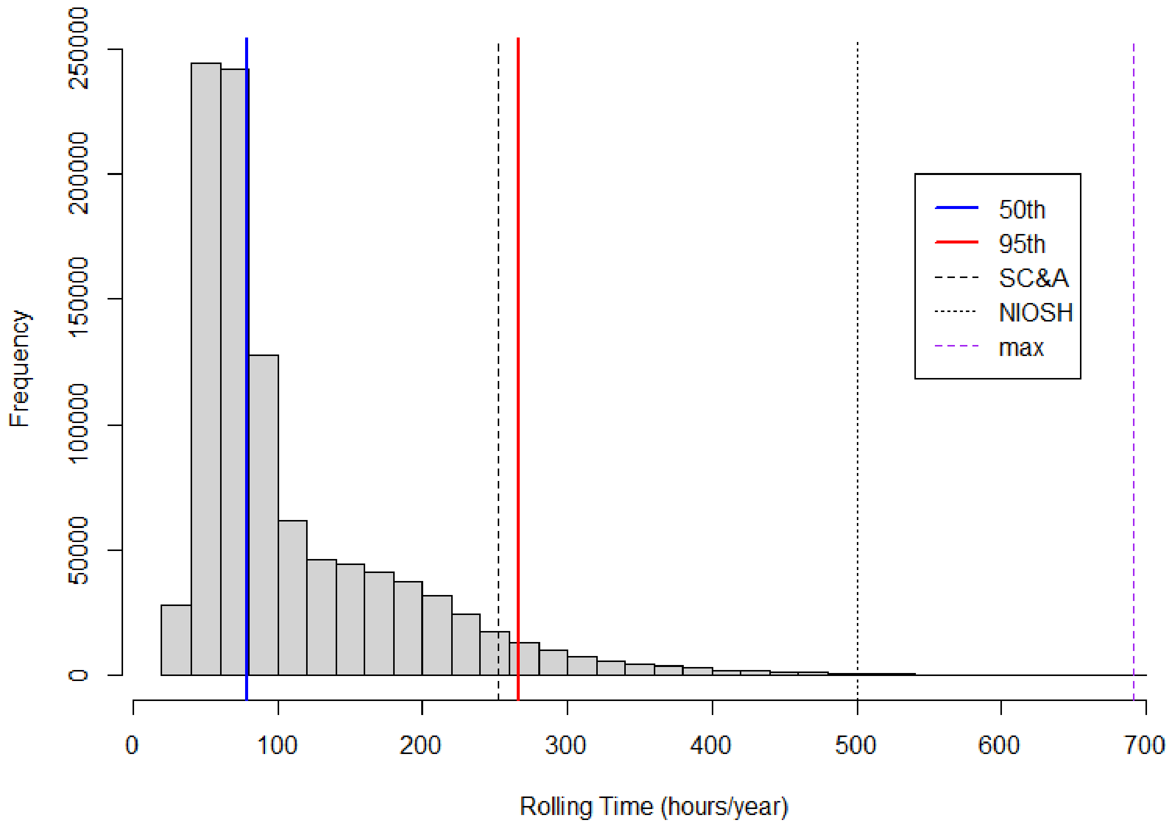

Figure 2. Histogram displaying the distribution of one million rolling time estimates, with various estimates being shown as vertical lines.

This simulation estimates a 50th percentile rolling time of 78 hours per year (in blue) and a 95th percentile rolling time of 267 hours per year (in red). For comparison, the SC&A estimate of 253 hours per year is shown by the black dashed line, and the original NIOSH estimate of 500 hours is shown by the black dotted line. As a point of reference, the maximum rolling time (using maximum annual payment, minimum slab weight, and minimum slabs per day) of 691 hours per year is shown by the purple dashed line.

CONCLUSION

After further review of the information presented here and the SC&A January 2020 response, NIOSH agrees with using the rolling time formula to determine a rolling time estimate. Given the variability in available input values presented here, NIOSH suggests exploring the rolling time distribution through the use of a simulation. NIOSH proposes using the 95th percentile of the simulated distribution, which is a rolling time of 267 hours per year. This simulation results in an estimate that is not much higher than SC&A's estimate of 253 hours per year but incorporates all of the available Superior Steel data.

REFERENCES

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