

DRAFT MEMO

TO: Uranium Refining Atomic Weapons Employers (AWEs) Work Group
FROM: W.C. Thurber, SC&A
DATE: September 22, 2011
SUBJECT: Use of Surrogate Air Sampling Data at Hooker Electrochemical Company:
Comparison of DCAS and SC&A Approaches

At the August 2011 meeting of the ABRWH, the Board requested that additional information be provided comparing the differences in the air sampling data sets used by the Division of Compensation Analysis and Support (DCAS) and SC&A to characterize internal exposures for workers at the Hooker Electrochemical Company (Hooker). This memorandum provides the requested comparison.

From July 11, 1944, through January 15, 1946, Hooker processed C-2 slag (basically MgF_2 and CaO) generated during the exothermic bomb reduction of UF_4 with Mg. The process at Hooker involved leaching of the slag with HCl to remove some of the slag constituents and increase the uranium content. The Hooker process was described at the time of AWE operations as follows (MED 1944):

Slag is received in barrels containing about 500 lbs. The barrels are opened and the material is dumped on a conveyor belt which carries it up a ramp to one of the three digest tanks. [The as-received material was passed over a 20-mesh screen and only the undersize was conveyed to the digester tanks. The oversize was re-drummed and shipped off-site.]¹ 40 barrels are added to each tank. Waste HCl from the P-45 plant is passed into the digest tank and the pH is adjusted to 4.0 by the addition of water. After the tank has been filled, the contents are agitated for 20 hours. About once in two days a tank is emptied, which is sufficient turn-over to take care of waste HCl. At the completion of the digest the slurry is neutralized by dumping 100-lb. bags of lime into the tanks from an overhead platform, pumped to a plate and frame press, and filtered. The filtrate is passed off into the sewer; the precipitate is washed several times and rebarreled. Slag is concentrated from about 1 lb. [of uranium] to 5 or 10 lbs. [of uranium] by weight.

Since no monitoring data were available at Hooker to characterize internal exposures, DCAS relied on surrogate data. In selecting the surrogate data for estimating internal exposure of AWE workers at Hooker, DCAS determined that relevant air sampling data were available from Fernald, Mallinckrodt (MCW) and ElectroMet that could be used to construct doses at Hooker. From the available literature sources, DCAS selected 18 measurements which, in their technical judgment, could be used for dose reconstruction. These data are summarized in Table 1 (DCAS 2011, Table 1).

¹ Bracketed comment added by SC&A.

Table 1. Magnesium Fluoride Air Samples

Site	Task	Air Concentration (dpm/m ³)	Comments	SRDB reference
ElectroMet	Loading slag into barrels and weighing	456	Average of unknown number of samples	8917 pg. 7
ElectroMet	Shoveling slag into drums	398	Average of three	8930 pg. 19
Mallinckrodt	Slag Man	154		9340 pg. 4
Mallinckrodt	Slag handling	154		11553
Mallinckrodt	Slag Man	77		9341 pg. 5
Mallinckrodt	Removing slag drum	237		9443 pg. 19
Mallinckrodt	Removing slag drum	60.8		9443 pg. 19
Fernald	BZ – dumping can of C-liner	247		34544
Fernald	BZ – dumping can of C-liner	191		34544
Fernald	BZ – dumping can of C-liner	255		34544
Fernald	BZ – dumping can of C-liner	206		34544
Fernald	BZ – dumping drum of C-liner	793		42627
Fernald	BZ – dumping drum of C-liner	829		42627
Fernald	BZ – dumping drum of C-liner	424		42627
Fernald	BZ – dumping drum of slag outdoors	32		42628
Fernald	BZ – dumping drum of slag outdoors	110		42628
Fernald	BZ – dumping drum of slag outdoors	85	Value calculated from average, min and max	42628
Fernald	BZ – dumping drum of slag outdoors	85	Value calculated from average, min and max	42628

It should be noted that a majority of the samples in Table 1 were breathing zone (BZ) samples from Fernald. From this sample set, DCAS determined that the 95th percentile was 806 dpm/m³ and used that datum as one piece of the information required to estimate internal exposures. SC&A reviewed the data set in Table 1 and provides the following observations:

- The MCW tasks Slag Man and Slag Handling as described in the SRDB references are for an operator grinding C-Special slag. We presume that this refers to the process of grinding adhering slag from the uranium derbies, rather than grinding slag for particle size reduction. In either case, these operations do not seem consistent with the process description for Hooker.
- If these tasks were eliminated from Table 1, the impact on the 95th percentile would be small, increasing its value from 806 dpm/m³ to 966 dpm/m³.

SC&A developed its air sampling data set based primarily on the same references by applying technical judgment as to which samples should be included and which should be excluded. SC&A recognizes that such judgments carry a significant degree of subjectivity. At the time SC&A prepared its review of the use of surrogate data at Hooker, we used a data set of 67 samples (SC&A 2011) and determined that the 95th percentile of the slag-handling air samples

was 555 dpm/m³. In addition to the Fernald samples included in the DCAS data set (Table 1), SC&A included data from three other Fernald operations described in SRDB 42628:

- “Laborer used push broom to clean loose material from floor of gondola. Material dry and very dusty. No respirator worn.” SC&A felt that this would be akin to sweeping up any spilled slag at the unloading dock at Hooker.
- “Laborer inside gondola with hatchet and shovel. Man cuts and shovels material from side of gondola and pitches onto pile on pad.” SC&A felt that similar measures might be required at Hooker to remove any caked product from the wooden shipping barrels.
- “Hand shoveling airport scrap into 30-gal containers on outside pad. No visible dust. No respirator worn.” SC&A felt that this activity was similar to reloading of oversized slag that was not processed, but re-barreled and shipped off-site.

SC&A also included four BZ samples from MCW for a task described as “changing slag drums” (SRDB 20657).

SC&A subsequently added three samples from Fernald that were uncovered during a September 2011 update of a previously reviewed reference (NLO 1959). The operation was described as “Operator dumping 55-gal drum of MgF₂ into leach tank, taking drum off and relidding drum,” and BZ exposures ranged from 1,125 to 1,674 dpm/m³. It is reasonable that similar exposures could have been incurred when slag was transferred to the digester tanks at Hooker.

A detailed comparison of the DCAS sample set and the SC&A sample set is provided in Table 2. As noted previously, DCAS had determined that the 95th percentile for the Table 1 sample set was 806 dpm/m³, while the 95th percentile value for the larger SC&A sample set (revised to September 2011) was 759 dpm/m³, indicating that the 95th percentile is not particularly sensitive to reasonable but differing technical judgments in sample selection.

Table 2. Summary of Air Sampling Results from Slag Handling at Fernald, ElectroMet and MCW

Site	Sample No.	Dust Count (dpm/m ³)	Type of Sample	Sample Location	Job Description	Included in NIOSH Analysis?	Included in SC&A Analysis?	SRDB Reference
Fernald	1639	198	BZ	Outside	Laborer used push broom to clean loose material from floor of gondola. Material dry and very dusty. No respirator worn.	No	Yes	42628, pg. 13
Fernald	1640	232	BZ	Outside	Ditto	No	Yes	
Fernald	1641	233	BZ	Outside	Ditto	No	Yes	
Fernald	1642	490	BZ	Outside	Ditto	No	Yes	
Fernald	1643	257	BZ	Outside	Ditto	No	Yes	
Fernald	1644	346	BZ	Outside	Ditto	No	Yes	

**Table 2. Summary of Air Sampling Results from Slag Handling at Fernald,
ElectroMet and MCW**

Site	Sample No.	Dust Count (dpm/m ³)	Type of Sample	Sample Location	Job Description	Included in NIOSH Analysis?	Included in SC&A Analysis?	SRDB Reference
Fernald	1645	261	BZ	Outside	Ditto	No	Yes	
Fernald	1646	200	BZ	Outside	Ditto	No	Yes	
Fernald	1647	627	BZ	Outside	Ditto	No	Yes	
Fernald	1648	336	BZ	Outside	Ditto	No	Yes	
Fernald	1649	195	BZ	Outside	Ditto	No	Yes	
Fernald	1650	338	BZ	Outside	Ditto	No	Yes	
Fernald	1105	15	BZ	Outside	Laborer inside gondola with hatchet and shovel. Man cuts and shovels material from side of gondola and pitches onto pile on pad.	No	Yes	42628, pg. 14
Fernald	1106	15	BZ	Outside	Ditto	No	Yes	
Fernald	1107	30	BZ	Outside	Ditto	No	Yes	
Fernald	1108	37	BZ	Outside	Ditto	No	Yes	
Fernald	1109	97	BZ	Outside	Ditto	No	Yes	
Fernald	1110	162	BZ	Outside	Ditto	No	Yes	
Fernald	1111	7	BZ	Outside	Ditto	No	Yes	
Fernald	1112	69	BZ	Outside	Ditto	No	Yes	
Fernald	1113	15	BZ	Outside	Ditto	No	Yes	
Fernald	1114	47	BZ	Outside	Ditto	No	Yes	
Fernald	1115	32	BZ	Outside	Ditto	No	Yes	
Fernald	1116	83	BZ	Outside	Ditto	No	Yes	
Fernald	1117	80	BZ	Outside	Ditto	No	Yes	
Fernald	1118	68	BZ	Outside	Ditto	No	Yes	
Fernald	1119	36	BZ	Outside	Ditto	No	Yes	
Fernald	1120	135	BZ	Outside	Ditto	No	Yes	
Fernald	1121	181	BZ	Outside	Ditto	No	Yes	
Fernald	1122	32	BZ	Outside	Ditto	No	Yes	
Fernald	1123	83	BZ	Outside	Ditto	No	Yes	
Fernald	1124	64	BZ	Outside	Ditto	No	Yes	
Fernald	1125	30	BZ	Outside	Ditto	No	Yes	
Fernald	1126	23	BZ	Outside	Ditto	No	Yes	
Fernald	1127	53	BZ	Outside	Ditto	No	Yes	
Fernald	1128	79	BZ	Outside	Ditto	No	Yes	
Fernald	1129	34	BZ	Outside	Ditto	No	Yes	
Fernald	1130	45	BZ	Outside	Ditto	No	Yes	
Fernald	1131	106	BZ	Outside	Hand shoveling airport scrap into 30-gal containers on outside pad. No visible dust. No respirator worn.	No	Yes	42628, pg. 16

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**Table 2. Summary of Air Sampling Results from Slag Handling at Fernald,
ElectroMet and MCW**

Site	Sample No.	Dust Count (dpm/m ³)	Type of Sample	Sample Location	Job Description	Included in NIOSH Analysis?	Included in SC&A Analysis?	SRDB Reference
Fernald	1132	91	BZ	Outside	Ditto	No	Yes	
Fernald	1133	75	BZ	Outside	Ditto	No	Yes	
Fernald	1134	38	BZ	Outside	Ditto	No	Yes	
Fernald	1135	7	BZ	Outside	Ditto	No	Yes	
Fernald	1136	19	BZ	Outside	Ditto	No	Yes	
Fernald	1137	95	BZ	Outside	Ditto	No	Yes	
Fernald	1138	75	BZ	Outside	Ditto	No	Yes	
Fernald	1139	49	BZ	Outside	Ditto	No	Yes	
Fernald	1140	45	BZ	Outside	Ditto	No	Yes	
Fernald	1141	30	BZ	Outside	Ditto	No	Yes	
Fernald	1142	19	BZ	Outside	Ditto	No	Yes	
Fernald	3556	110	BZ	Outside	Operator dumping drum of slag liner into outside crusher dumping station. No respirator worn, Ventilation appears to be very effective.	Yes	Yes	42628, pg. 90
Fernald	3472	108	BZ	Outside	Ditto	Yes	Yes	
Fernald	3558	61	BZ	Outside	Ditto	Yes	Yes	
Fernald	3557	32	BZ	Outside	Ditto	Yes	Yes	
Fernald	6993	793	BZ	inside	Operator dumping drum of C-liner from 2nd floor drum dumper	Yes	Yes	42627, pg. 61
Fernald	7509	829	BZ	inside	Ditto	Yes	Yes	
Fernald	7302	424	BZ	inside	Ditto	Yes	Yes	
Fernald	626	247	BZ	inside	BZ dumping can of C-liner into dumping station. Respirator worn	Yes	Yes	34544, pg. 2
Fernald	623	191	BZ	inside	Ditto	Yes	Yes	
Fernald	736	255	BZ	inside	Ditto	Yes	Yes	
Fernald	T899	206	BZ	inside	Ditto	Yes	Yes	
ElectroMet	III. 2 & 6	456	BZ??	inside	Bomb Room, barrel slag and weigh	Yes	Yes	8917, pg. 7
ElectroMet	N/A	398	BZ??	inside	Shovels slag into lean and rich drums	Yes	Yes	8930, pg. 19
MCW	Nov-53	107	BZ	inside	Breakout man changing C-oxide and slag liner drums	No	Yes	20657, pp. 11 and 23
MCW	Nov-53	7	BZ	inside	Ditto	No	Yes	
MCW	Apr-53	81	BZ	inside	Ditto	No	Yes	
MCW	Oct-52	27	BZ	inside	Ditto	No	Yes	
MCW	A	237	BZ	inside	Bomb unloaders	Yes	Yes	9343, pg. 19

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Table 2. Summary of Air Sampling Results from Slag Handling at Fernald, ElectroMet and MCW

Site	Sample No.	Dust Count (dpm/m ³)	Type of Sample	Sample Location	Job Description	Included in NIOSH Analysis?	Included in SC&A Analysis?	SRDB Reference
					removing C-special drum			
MCW	B	60.8	BZ	inside	Ditto	Yes	Yes	
MCW	1948	154	DWA	inside	Slag Man grinding C-special	Yes	No	9340, pp. 4, 16, and 50
MCW	1949	79	DWA	inside	Ditto	Yes	No	
MCW	1950	79	DWA	inside	Ditto	No	No	9341, pp. 6 and 38
MCW		154	DWA	inside	Ditto (duplicate of MCW 1948)	Yes	No	11553, pp. 6 and 53
Fernald	4906	1125	BZ	inside	Operator dumping 55-gal drum of MgF ₂ into leach tank, taking drum off and relidding drum.	No	Yes	42628, pg. 93
Fernald	4907	1674	BZ	inside	Ditto	No	Yes	
Fernald	4908	1533	BZ	inside	Ditto	No	Yes	

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