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Site Profiles for Atomic Weapons Employers that Refined Uranium and Thorium - Appendix C Electro Metallurgical Company	
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RECORD OF ISSUE/REVISIONS			
ISSUE AUTHORIZATION DATE	EFFECTIVE DATE	REV. NO.	DESCRIPTION
12/21/2007	12/21/2007	0	Appendix to Battelle-TBD-6001 describing the use of the TBD for claims at Electro Metallurgical Company

C.1 Introduction

This document serves as an appendix to Battelle-TBD-6001, Site Profiles for Atomic Weapons Employers that Refined Uranium and Thorium. 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.

C.2 Site Description

The Electro Metallurgical Company uranium operations were located south of Pine Ave and east of its intersection with Packard Road, Niagara Falls, New York. Available information indicates that all uranium operations (including the business office, lunchroom, and shipping areas) were conducted within a single building. The building was a one-story cinder block and wood structure, which measured approximately 50 feet by 219 feet located in an area now occupied by the current Building 166 of the Union Carbide Corporation building complex. (Ref ID 16282). Initial furnace operations for uranium processing began in April 1943 (RefID 4125, p31) and at full operations three shifts per day were run.

C.2.1 Site Activities

The plant was to take uranium tetrafluoride and convert it to uranium metal by heating the uranium salt with magnesium and casting into 110-135 kilogram ingots. Contract MED W-7405-Eng-14 initiated design, engineering, construction, and operation of the plant. (RefID 16282, p 2,3). Uranium production at the Electro Metallurgical Company

began in April 1943 and appears to have run continuously until August 1946. Uranium production operations were suspended from August 1946 to October 1947 (RefID 16282). Operations continued from October 1947 until production was stopped on September 28, 1949 and placed in standby on September 30, 1949.

In April 1950, the UF₄-to-metal plant was reactivated for casting zirconium metal sponge into ingots for the Navy Critical Requirement program. The zirconium metal operations did not pose a radiological hazard other than exposure to residual uranium remaining since cessation of uranium operations in 1949. Uranium handling from January-June 1951 may have occurred based on contract that: "... directed Union Carbide to conduct research and development of methods of forming metal that would minimize unnecessary machining, finishing, and waste". Although the contract is not specific, the metal involved is presumed to be uranium.

The AEC involvement with the site ended when contract W-7405-Eng. 14 expired on June 30, 1953 (RefID 16282). No documentation was found indicating there were other sources of radiation at Electro Metallurgical during the covered period between 1942 and 1953.

Operational and standby periods are outlined in the table below. For the purposes of dose reconstruction, time periods in which no uranium work was occurring are defined as standby even though other processes were occurring.

Table C.1 – Operating History

	Start	Stop
Operations	4/1/1943	8/31/1946
Standby	9/1/1946	9/30/1947
Operations	10/1/1947	9/30/1949
Standby	10/1/1949	1/1/1951
Operations	1/1/1951	6/30/1951
Standby	6/30/1951	6/30/1953

C.3 Occupational Medical Dose

A memo reviewing the medical program at Electro Metallurgical was written by the MED in 1945 (RefID 21849). The memo recommended pre-employment, annual and termination x-rays. No information regarding occupational medical dose was found in any of the site research or CATI materials. Information to be used in dose reconstructions, for which no specific information is available, is provided in ORAUT-OTIB-0006, the dose reconstruction project technical information bulletin covering diagnostic x-ray procedures. The assumed frequency in this document is pre-employment, annual and termination x-rays between the years 1942 and 1953 (the covered period).

C.4 Occupational External Dose

Film badge results were found for operators at Electro Metallurgical taken between June 1948 and September 1949. While some reports included operator names and job titles, others did not. In order to include all the data, all badge readings were combined into one large population. This appears to be reasonable from the statistics developed from the population. Badges were issued weekly and both photon (gamma) and electron (beta) radiation was measured.

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The data set was assumed to be lognormally distributed. When analyzed, the geometric mean of the distribution was 20.06 mr/week photons and 64.43 mr/week beta. The geometric standard deviation for the weekly readings was 2.30 and 3.13 respectively.

Since the badge results that did have job descriptions associated with them represented a mixture of job types, it is possible that assigning the distribution would underestimate some workers while overestimating others. Therefore, workers will be assigned to one of three categories, Operators, Supervisors and laborers, and Others. Operators are those that routinely worked directly with uranium. The supervisors and laborers category is for workers that were routinely in the areas where uranium operations occurred but were not routinely handling uranium directly. Maintenance personnel fall into this category. The Others category is for personnel that did not routinely enter the areas where uranium was handled. Operators are assigned the 95th percentile of the annual dose. Supervisors and laborers are assigned the 50th percentile of the distribution and the Others category is assigned the 5th percentile of the distributions. Since these represent bounding estimates, the dose is assigned as a constant.

Uranium operations were suspended three times during the covered period at the site. Since operations were suspended, it is unlikely anyone routinely handled uranium or uranium processing equipment. Also, the uranium inventory was likely reduced if not eliminated. Therefore, during those times, all personnel will be assigned dose based on the "Other" category. This is intended to account for external dose that would be received from residual uranium contamination that may have remained. Also, uranium operations did not start until April 1943. Therefore, no external dose will be assigned before then.

C.5 Occupational Internal Dose

Air samples were collected in various areas of the plant in 1948 and 1949. These air samples were combined with time motion studies of various tasks to obtain a daily weighted average of the air concentration inhaled. For this exposure estimate, these tasks were broken up into three categories of tasks, Operator, Supervisor/Laborer, and Other. The Operator category is for those that routinely handled uranium or operated uranium processing equipment. The Supervisor/Laborer category is for those that are routinely in the uranium handling areas and did handle uranium or uranium processing equipment but not on a routine bases. Examples of people fitting this category are foremen, guards, maintenance personal and janitors. Laboratory technicians and chemist also fit this category because they are routinely handling uranium but not in production quantities. The third category of personnel is "Other". This is for those that do not routinely enter the uranium production areas. Examples of this are office personnel and store room attendants.

The daily weighted air samples were divided into these three categories. The distribution from each group of air samples was determined. Because there was a limited number of samples, the 95th percentile of each distribution will be assigned. Because this represents a bounding assumption, the value will be assigned as a constant. These values will also be used to estimate ingestion intakes per the requirements of OCAS-TIB-009.

Uranium operations were suspended three times during the covered period at the site. Since operations were suspended, it is unlikely anyone routinely handled uranium or uranium processing equipment. Also, the uranium inventory was likely reduced if not eliminated. Therefore, during those times, all personnel will be assigned dose based on

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the "Other" category. This is intended to account for internal dose that would be received from residual uranium contamination that may have remained. Also, uranium operations did not start until April 1943. Therefore, no internal dose will be assigned before then.

For internal dose estimates, the uranium will be considered to be type M or type S solubility. The dose estimate should be based on the one that produces the highest dose. The time weighted averages indicated a normal work day of 515 minutes, 8 hours work plus 20 minutes for lunch and 15 minutes in the locker room to change cloths. The dose estimate will be based on this 515 minutes per day, 5 days per week and 50 weeks per year.

C.6 References

1. DOE Office of Health, Safety and Security, EEOICPA web site.
<http://www.hss.energy.gov/healthsafety/fwsp/advocacy/faclist/findfacility.cfm>
2. NIOSH, 2007, *Radiation exposures covered for Dose Reconstructions under Part B of the Energy employees Occupational Illness Compensation Program Act Rev. 0*, OCAS-IG-003, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio.
3. NIOSH, 2004, *Estimation of Ingestion Intakes Rev. 0*, OCAS-TIB-009, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio.
4. RefID 4125 Atomic Energy Commission, 1951, *The Production of Uranium Feed Materials*, May 22, 1951
5. RefID 16282 UMETCO Minerals Corporation, *History UMETCO Minerals Co. Former Electro Metallurgical, Niagara Falls*
6. RefID 21849 B. J. Mears, 1945, *Memo to Area Engineer, Tonawanda Area*, May 4, 1945

Table C.2 INTERNAL DOSE PATHWAYS - Inhalation of Airborne Radionuclides**Assumptions:**

Intakes are in dpm per calendar day.

Dose entered into IREP as alpha radiation

Dose value is a constant (no distribution)

Job Category	Year	Operation Phase	Relevant Nuclide	Intake (dpm/d)	TBD Reference or Research Justification
Operators	See table C.1	Operations	U234	60661	Air sample data
Supervisors/Laborers	See table C.1	Operations	U234	8159	Air sample data
Other	See table C.1	Operations	U234	473	Air sample data
All	See table C.1	Standby	U234	473	Air sample data

Table C3 INTERNAL DOSE PATHWAYS - Ingestion

Assumptions:

Intakes are in dpm per calendar day.

Dose entered into IREP as alpha radiation

Dose value is a constant (no distribution)

Job Category	Year	Operation Phase	Relevant Nuclide	Intake (dpm/d)	TBD Reference or Research Justification
Operators	See table C.1	Operations	U234	1178	Air sample data
Supervisors/Laborers	See table C.1	Operations	U234	158	Air sample data
Office	See table C.1	Operations	U234	9.2	Air sample data
All	See table C.1	Standby	U234	9.2	Air sample data

Table C.4 EXTERNAL DOSE PATHWAYS - Whole Body

Based on weekly film badge results and 50 weeks per year of work.

Job Category	Year	Operation Phase	Whole body (mr/yr)	TBD Reference or Research Justification
Operators	See table C.1	Operations	3934	Film badge data
Supervisors/Laborers	See table C.1	Operations	1003	Film badge data
Office	See table C.1	Operations	256	Film badge data
All	See table C.1	Standby	256	Film badge data

Table C.5 EXTERNAL DOSE PATHWAYS - Skin

Assumptions:

Based on weekly film badge results and 50 weeks per year of work.
 Doses are entered into IREP as Electron >15kev
 These doses are in addition to the Whole Body doses in Table C.4

Job Category	Year	Operation Phase	Other Skin (mr/yr)	TBD Reference or Research Justification
Operators	See table C.1	Operations	21030	Film badge data
Supervisors/Laborers	See table C.1	Operations	3221	Film badge data
Office	See table C.1	Operations	493	Film badge data
All	See table C.1	Standby	493	Film badge data