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Appendix AA – Hooker Electrochemical Company	
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HOOKER ELECTROCHEMICAL COMPANY

AA.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.

AA.2 Site Description

The Hooker Electrochemical Company (HEC) was located in Niagara Falls, New York. From January, 1943 until June, 1948 under contract No W-7405 eng-28 with the Manhattan Engineering District (MED), HEC manufactured various organic chemicals including xylene hexafluoride (P-45), xylene hexachloride, and Miller's Fluoro Lubricant (MFL). While these processes in themselves did not involve radioactive materials, during part of this period, hydrochloric acid, a byproduct of the P-45 process, was used to chemically treat uranium bearing C-2 slag as a precursor to uranium recovery (Ref ID 11002, pg 58).

The HEC site used under the MED program was the "D" area, 5.5 acres located on the north bank of the Niagara River in Niagara Falls, NY, about 2 miles east of the falls. Five buildings on this site, D-5, 6, 7, 8 and 9 were used under the contract with MED (1943-48). The bulk of uranium handling was conducted outdoors in an area by the railroad

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siding north of these buildings. This activity involved the chemical processing of uranium-bearing slag for recovery purposes (Ref ID 11002, pg 39, 58).

The covered period for Hooker Electrochemical is listed by the Department of Energy's Office of Worker Advocacy as 1943 through 1948 and includes both radioactive material processing and nonradioactive chemical production activities for the Manhattan Engineer District (MED)¹. The only weapons-related radiation exposure occurred while processing of uranium contaminated slag for MED. A 49' x 28' x 25' cinder block building to contain some of the necessary equipment was constructed under a letter of intent dated May 1944. Construction was completed and the building turned over to the Operating Department on July 11 1944 (Ref ID 11002, pg 112). No documentation was found indicating there were other sources of radiation, commercial or weapons-related, at Hooker Electrochemical.

A process description indicates this process was sufficient to take care of the excess HCl from the P-45 process (Ref ID 16323, pg 29-30). The P-45 process ended on January 15, 1946 (Ref ID 17125, pg 29). This document establishes the period of operational radiation exposure from July 11, 1944 to January 15, 1946. It is possible that the slag-processing occurred for an even shorter period since some start up period would be expected. This analysis assumes a period of residual radioactivity exposure from January 16, 1946 to October 11, 1976, the date when measurements for radiation and radioactivity onsite were made and it was concluded that no elevated levels of radioactivity were onsite (Ref ID 10797, pg 11).

AA.2.1 Site Activities

The MED radiation work at Hooker Electrochemical was the concentration of uranium from slag, which had been sent to the Hooker site from the Electrometallurgical Company (Ref ID 11002, pg 58). This material was primarily reduction bomb (dolomite) liners with an approximate composition of 90% magnesium fluoride and 10% calcium oxide. (The term bomb, as used here, refers to a device used to contain a particular chemical process.) The slag reportedly contained approximately one pound of uranium per 500 pounds of slag (Ref ID 16323, pg 29-30). A former employee indicated, "All the uranium handling was done outdoors in an area adjacent to the railroad siding located north of the MED buildings;" however the completion of the cinder block building (49'x28'x25') in July 1944 indicate some of the uranium work occurred indoors (Ref ID 11002, pg 112).

A description of the process is contained in a Data Sheet for Industrial Hazards, dated December 8, 1944 (Ref ID 16323, pg 29-30).

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. 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

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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.

A former employee remembered the process started by dumping approximately 20 barrels per day (approximately 5 tons), then the work increased to approximately 40 barrels per day (approximately 10 tons). The Data Sheet for Industrial Hazards indicated the production rate was 10 tons per month. A War Department memo dated 3/8/1945 requested medical clearance for the termination of the Hooker Electrochemical contract. This memo indicated a total of 152 tons of slag were processed through this system and that it operated from July 1944 through January 15, 1946 (Ref ID 17125, pg 29-30). At 10 tons per month, this timeframe would equal 180 tons. This appears to be consistent with the former employee who indicated the process rate started slower but then increased. Taken together, these sources indicate the barrels were emptied approximately one day per month. They also imply only the liquid contents were decanted off approximately every two days and replaced with additional hydrochloric acid. At the completion of the digestion, the remaining material was neutralized, filtered and drummed for shipment.

AA.2.2 Job Categories

Each claim will be evaluated to determine the most appropriate Job Category from the list below.

Plant Floor High (Involved directly in operations)
Plant Floor Low (Involved in support of operations)
Supervisor
Clerical

AA.3 Occupational Medical Dose

The War Department memo dated 3/8/1945 indicated the medical requirements included a pre-employment exam including a chest x-ray as well as a monthly blood count and monthly urinalysis. It also indicates there were no special exams and that this schedule was not adhered to after the first year of operation (Ref ID 17125, pg 29-30). No other information regarding occupational medical dose specific to Hooker Electrochemical was found. 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 assigned frequency should be only a pre-employment chest x-ray.

AA.4 Occupational Internal Dose

No data were found in the Site Research database related to occupational internal dose during AEC work. The work performed at Hooker Electrochemical involved

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concentrating C-2 slag material using hydrochloric acid (HCl). Therefore, the air concentration values in this TBD for "Scrap Recovery" are used to calculate internal doses. The dumping operation was assumed to be similar to the Furnace operator (trays) since that provides the highest air concentration for scrap recovery. This operation was assumed to take place one day per month or 5% of the work time. For the remaining time, the primary operation was to allow the slag to digest in tanks of HCl. However, there was some decanting and eventually some filtering of the concentrated slag. This operation was assumed to be similar to the filtering done for scrap recovery.

The uranium concentration in the C-2 slag was below what was normally considered economically feasible for recovery. According to the process description, the slag contained about 1 pound of uranium in a 500 pound barrel or about 0.2% uranium by mass. This TBD provides a value for the furnace operator (pre-1951) based on a geometric mean air concentration of 822 dpm/m³ uranium. This is equivalent to 0.587 mg/m³ of uranium. Since the uranium is approximately 0.2% of the material, this is equal to a dust concentration in the air of 293 mg/m³. This is an extremely high dust concentration. It is likely high dust concentrations resulted from the dumping operation; however, it is also likely this value will bound the concentration that could have been present when averaged over an entire work day. Therefore, the geometric mean values in this TBD are considered bounding and will be used as a constant.

Similarly, the filtrate contained about 2% uranium mass concentration while the filtrate from typical scrap recovery operations would be much higher. Therefore, the geometric mean values in this TBD are considered bounding and will be used as a constant.

AA.5 Occupational External Dose

No data were found in the Site Research database related to occupational external dose during AEC work. The work performed at Hooker Electrochemical involved concentrating C-2 slag material using HCl. Therefore, the external dose rates in the TBD for "Scrap Recovery" are used to calculate external doses. All the values will be used for 5% of the time (1 day per month) for the barrel dumping operations. Only the value related to surface contamination will be used for the remaining time.

The uranium concentration in the C-2 slag was below what was normally considered economically feasible for recovery. According to the process description, the slag contained about 1 pound of uranium in a 500 pound barrel or about 0.2% uranium by mass. As with the internal dose section of this appendix, the geometric mean value will be considered a bounding estimate of external radiation exposure due to the low concentration in the slag compared to the material used in the operations used to derive the TBD values.

AA.6 Residual Contamination

For the purposes of this appendix, the residual contamination period at Hooker Electrochemical is considered to begin on January 15, 1946 and end on 10/11/1976. The end date is based on the Residual Contamination report² and the date of the radiological

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survey that concluded that no elevated levels of radioactivity were onsite (Ref ID 10797, pg 11).

The external dose rates used during this period are the dose rates contained in the TBD from the surface contamination only for scrap recovery operations. As with the internal and external dose sections of this appendix, the geometric mean value will be considered a bounding estimate of external radiation exposure due to the low concentration in the slag compared to the material used in the operations used to derive the TBD values.

The internal dose rates are based on the average air concentration during operations (from section C.4) assumed to deposit throughout an entire work year with no removal. This deposited contamination is assumed to resuspend with a resuspension factor of $1E-6 \text{ m}^{-1}$.

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AA.7 References

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<http://www.hss.energy.gov/healthsafety/fwsp/advocacy/faclist/findfacility.cfm>
2. Report on Residual Radioactive and Beryllium Contamination at Atomic Weapons Employer Facilities and Beryllium Vender Facilities.
<http://www.cdc.gov/niosh/ocas/pdfs/tbd/rescon/rcontam1206.pdf>
3. RefID 10797 U.S. Department of Energy, 1977, Formerly Utilized MED/AEC Sites Remedial Action Program, Radiological Survey of the Hooker Chemical Company, Niagara Falls, New York, Final Report, Washington, D.C., January.
4. RefID 11002 pp. 39 F.T. Olotka, 1979, *Letter to William E Mott regarding review and comments of a March 1979 letter to J Gallery*. April 18
5. RefID 11002 pp. 58 U.S. Department of Energy, 1985, *Formerly Utilized Sites Remedial Action Report Elimination Report for Occidental Chemical Corporation (Former Hooker Electrochemical Company) Niagara Falls, New York, Washington, D.C.*
6. RefID 11002 pp. 102-112 Dowling, Francis A., c. 1944, *Completion Report, Construction of Hooker Electrochemical Company P-45 Plant*, Contract No. W-7405-ENG-28, Tonawanda Area-Manhattan District.
7. RefID 16323 pp. 29-30 Manhattan District, 1944, "Medical Section – Manhattan District, Data Sheets for Industrial Hazard Rating".
8. RefID 17125 pp. 29-30 Mears, B.J., 1946, memorandum to The District Engineer, "Medical Clearance on Terminated Madison Square Area Contracts," Manhattan District, Oak Ridge, Tennessee, March 8.

Table AA.1 INTERNAL DOSE PATHWAYS - Inhalation of Airborne Radionuclides

Assumptions:

TBD Table 8.29, Scrap Recovery Furnace Operator (Trays)

Conversion Factor :2.22 dpm/pCi

Breathing Rate: 1.2 m³/hour

All intakes and doses are the operational and residual period specified in the appendix, not full years.

Job Category	Year	Operation Phase	Relevant Nuclide	Intake (pCi/d)	TBD Reference or Research Justification
Plant Floor High	1944-1946	Operations	U234	156	TBD-6001 Table 8.29 and appendix text
Plant Floor Low	1944-1946	Operations	U234	78	TBD-6001 Table 8.29 and appendix text
Supervisor	1944-1946	Operations	U234	39	TBD-6001 Table 8.29 and appendix text
Clerical	1944-1946	Operations	U234	3.9	TBD-6001 Table 8.29 and appendix text
All	1946-1976	Residual	U234	1.0	appendix text

Table AA.2 INTERNAL DOSE PATHWAYS - Ingestion**Assumptions:**

TBD Table 8.30, Scrap Recovery Furnace Operator (Trays)

Conversion Factor :2.22 dpm/pCi

Breathing Rate: 1.2 m³/hour

All intakes and doses are the operational and residual period specified in the appendix, not full years.

Job Category	Year	Operation Phase	Relevant Nuclide	Intake (pCi/d)	TBD Reference or Research Justification
Plant Floor High	1944-1946	Operations	U234	1.45E+00	TBD-6001 Table 8.30 and appendix text
Plant Floor Low	1944-1946	Operations	U234	7.27E-01	TBD-6001 Table 8.30 and appendix text
Supervisor	1944-1946	Operations	U234	3.64E-01	TBD-6001 Table 8.30 and appendix text
Clerical	1944-1946	Operations	U234	3.64E-02	TBD-6001 Table 8.30 and appendix text
All	1946-1976	Residual	U234	9.42E-03	appendix text

Table AA.3 EXTERNAL DOSE PATHWAYS - Whole Body**Assumptions:**

TBD Table 7.3, Scrap Recovery

Conversion Factor :2.22 dpm/pCi

Breathing Rate: 1.2 m³/hour

All intakes and doses are the operational and residual period specified in the appendix, not full years.

Job Category	Year	Operation Phase	Whole body (mr/d)	TBD Reference or Research Justification
Plant Floor High	1944-1946	Operations	4.02E-01	TBD-6001 Table 7.3 and appendix text
Plant Floor Low	1944-1946	Operations	2.01E-01	TBD-6001 Table 7.3 and appendix text
Supervisor	1944-1946	Operations	1.01E-01	TBD-6001 Table 7.3 and appendix text
Clerical	1944-1946	Operations	1.01E-02	TBD-6001 Table 7.3 and appendix text
Plant Floor High	1946-1976	Residual	3.76E-01	TBD-6001 Table 7.3 and appendix text
Plant Floor Low	1946-1976	Residual	1.88E-01	TBD-6001 Table 7.3 and appendix text
Supervisor	1946-1976	Residual	9.40E-02	TBD-6001 Table 7.3 and appendix text
Clerical	1946-1976	Residual	9.40E-03	TBD-6001 Table 7.3 and appendix text

Table AA.3 EXTERNAL DOSE PATHWAYS - Skin

Assumptions:

TBD Table 7.3, Scrap Recovery

Conversion Factor :2.22 dpm/pCi

Breathing Rate: 1.2 m³/hour

All intakes and doses are the operational and residual period specified in the appendix, not full years.

Job Category	Year	Operation Phase	Hand/Forearms (mr/d)	Other Skin (mr/d)	TBD Reference or Research Justification
Plant Floor High	1944-1946	Operations	11.0	0.98	TBD-6001 Table 7.3 and appendix text
Plant Floor Low	1944-1946	Operations	5.5	0.49	TBD-6001 Table 7.3 and appendix text
Supervisor	1944-1946	Operations	2.7	0.24	TBD-6001 Table 7.3 and appendix text
Clerical	1944-1946	Operations	0.3	0.02	TBD-6001 Table 7.3 and appendix text