

<p>Document Title:</p> <p><b>Site Profiles for Atomic Weapons Employers that Worked Uranium and Thorium Metals</b></p> <p><b>Appendix AS – Copperweld Steel Co.</b></p>	<p>Document Number: Battelle-TBD-6000 Appendix AS</p> <p>Revision: 0</p> <p>Effective Date: 7/16/2007</p> <p>Type of Document: TBD Appendix</p> <p>Supersedes: None</p>
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## Copperweld Steel Company

### AS.1 Introduction

This document serves as an appendix to Battelle-TBD-6000, Site Profiles for Atomic Weapons Employers that Worked Uranium and Thorium Metals. This appendix describes the results of document research specific to this site, the Copperweld Steel Company of Warren, Ohio. Where specific information is lacking, research into similar facilities described in the body of this Site Profile is used.

### AS.2 Site Description

The Copperweld Steel Company of Warren, Ohio straightened and outgassed a large number of rods for use in the Oak Ridge and Hanford reactors. <sup>1</sup>

#### AS.2.1 Site Activities

From May through August, 1943, the Copperweld Steel Co. straightened and outgassed approximately 3000 uranium rods for the Oak Ridge and Hanford reactors. To accomplish this work, the rods were packed into 10" diameter steel tubes. The ends of the steel tubes were capped, leaving small openings at either end. In order to "outgas" hydrogen from the uranium rods, argon gas was passed through the steel tubes while they were heated in a furnace to 1200°F. Heating took approximately 6 hours, after which the rods were removed from the steel tubes, cooled slightly, straightened using a special machine, and boxed for shipment. According to site documents reviewed, operations were carried out on an irregular schedule with three crews of 17 men each. <sup>2</sup>

No documentation was found indicating that workers exposed to AEC-related radioactive materials were exposed to other sources of radiation.

#### AS.2.2 Job Categories

The exposure assessment job categories include:

Plant Floor High	(Involved directly in straightening, or other machining operations)
Plant Floor Low	(Involved in support of machining operations or in heating/melting operations)
Supervisor	(Assumed to spend some time in the production areas)
Clerk	(Assumed to have minimal exposure)

### AS.3 Occupational Medical Dose

No information regarding occupational medical dose specific to Copperweld Steel Company was found. Nevertheless, 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.

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#### **AS.4 Occupational Internal Dose**

No sampling data were found in the site research database for activities taking place during the AWE period at this facility. Therefore, default exposure levels found in Table 7.5 of this TBD should be used (this table contains exposure levels associated with straightening operations). Based on the documentation in the file, the straightening machine produced the highest exposure levels, by far.<sup>3</sup> According to documents in the site research database, straightening and outgassing operations took place for 3 months during 1943. The work was reportedly irregular in schedule. However, since no specific dates were listed, the favorable assumption was made that work took place continuously for four months (May 1-August 31, 1943).

Other job categories should be scaled as follows for internal exposures:

- Plant floor low—50% of plant floor high exposure
- Supervisor—25% of plant floor high exposure
- Clerical—10% of supervisor exposure (2.5% of plant floor high)

Tables AS.2 and AS.3 contain inhalation and ingestion intakes in terms for pCi per day for each job category and each year.

#### **AS.5 Occupational External Dose**

There was no information in the site research database with respect to external exposures. Although documentation in the file indicates that dust sampling and radiation surveys had been performed, and that employees involved in handling the rods wore film badges, the results of these surveys were not found in the site research database.

Given the lack of contemporaneous survey data, external doses from airborne contamination and surface contamination are calculated based on airborne contamination levels as described above. This Battelle TBD provides guidance for calculating external doses associated with submersion and surface loading based on airborne contamination levels (which, as described in the previous section, are also estimated based on default values found on Table 7.5).

The uranium rods themselves would also constitute another source of external exposure during the AWE work at this facility. Operators handling the rods would receive external exposures from the betas and gammas emitted from the uranium. Methods described in Section 6 of this TBD were used to estimate whole body and skin doses from handling uranium metal.

Tables AS.4 and AS.5 contain external doses associated with the work at this facility.

#### **AS.6 Residual Contamination**

The NIOSH “Report on Residual Radioactive and Beryllium Contamination at Atomic Weapons Employer Facilities and Beryllium Vender Facilities” indicates that: “...there is little potential for significant residual contamination outside the period in which weapons-related production occurred.”<sup>4</sup>

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## **AS.7 References**

1. DOE Office of Health, Safety and Security, EEOICPA web site.  
<http://www.hss.energy.gov/healthsafety/fwsp/advocacy/faclist/findfacility.cfm>
2. Memorandum to Dr. Warren, Chief of Medical Section, Manhattan District, Rochester, NY, from John L. Perry, 20 September, 1943. Reference No. 16606.
3. Ibid.
4. 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>  
<http://www.cdc.gov/niosh/ocas/pdfs/tbd/rescon/appen-a2.pdf>

**Table AS.1 INTERNAL DOSE PATHWAYS - Inhalation of Airborne Radionuclides****Assumptions:**Operational Period Daily Weighted Average Air Concentration, Plant Floor High: 1690 dpm/m<sup>3</sup>

Residual Period Daily Weighted Average Air Concentration: Not applicable

TBD GSD Default is 5

Conversion Factor: 2.22 dpm/pCi

Breathing Rate: 1.2 m<sup>3</sup>/hour

All intakes and doses assume full-time employment for the given year.

Job Category	Year	Operation Phase	Hr/Yr	Relevant Nuclide	Intake (pCi/d)	GSD	TBD Reference or Research Justification
Plant Floor High	1943	Operations	670	U234	1.68E+03	5.0	TBD-6000 Table 7.5
Plant Floor Low	1943	Operations	670	U234	8.38E+02	5.0	TBD-6000 Table 7.5
Supervisor	1943	Operations	670	U234	4.19E+02	5.0	TBD-6000 Table 7.5
Clerical	1943	Operations	670	U234	4.19E+01	5.0	TBD-6000 Table 7.5

**Table AS.2 INTERNAL DOSE PATHWAYS - Ingestion of Airborne Radionuclides****Assumptions:**Air Concentration to Intake Conversion Factor:  $3.06E-05 (M^3/d)/(hr/y)$  - see 7.1.6 TBD-6000

Deposition velocity: 0.00075 m/s

Resuspension Factor:  $1.00E-06 1/m$ 

Job Category	Year	Operation Phase	Hr/Yr	Relevant Nuclide	Intake (pCi/d)	GSD	TBD Reference or Research Justification
Plant Floor High	1943	Operations	670	U234	1.56E+01	5.0	TBD-6000 Table 7.5
Plant Floor Low	1943	Operations	670	U234	7.81E+00	5.0	TBD-6000 Table 7.5
Supervisor	1943	Operations	670	U234	3.90E+00	5.0	TBD-6000 Table 7.5
Clerical	1943	Operations	670	U234	3.90E-01	5.0	TBD-6000 Table 7.5

**Table AS.3 EXTERNAL DOSE PATHWAYS - Whole Body****Assumptions:**Submersion Dose Conversion Factor: 2.462E-09 mrem/h/dpm/m<sup>3</sup>

Deposition velocity: 0.00075 m/s

Contaminated Surface Dose Conversion Factor: 5.615E-10 mrem/h/dpm/m<sup>2</sup>

All external dose from estimated exposure to uranium slugs

Residual period: Assume no handling of U metal - only exposure is from residual contamination on floor and in air

Job Category	Year	Operation Phase	Hr/Yr	Relevant Nuclide	External Whole Body (mR/d)	GSD	TBD Reference or Research Justification
Plant Floor High	1943	Operations	670	U234	5.26E-01	5.0	Generic Metal TBD, Section 6.3
Plant Floor Low	1943	Operations	670	U234	2.63E-01	5.0	Generic Metal TBD, Section 6.3
Supervisor	1943	Operations	670	U234	2.69E-02	5.0	Generic Metal TBD, Section 6.3
Clerical	1943	Operations	670	U234	7.90E-05	5.0	Generic Metal TBD, Section 6.3

**Table AS.4 EXTERNAL DOSE PATHWAYS - Skin****Assumptions:**

All assumptions from TBD-6000 Section 6.3

Operational Period: Non-penetrating dose to skin 115 mR/hour (hands and forearms) 10.4 mR/hour (other)

Plant Floor High: Assume hands in contact with metal 50% of time. Other skin is 100% of dose rate at 1-ft, 20.8 mrem/h

Plant Floor Low: 50% of Plant Floor High

Supervisor: assume 10% of Plant Floor Low for time in contact with metal

Clerical: assume no handling of U metal.

Residual Period: Non-penetrating dose to skin 3.9E-06 mr/hour

Assume no handling of U metal.

Assume 10x the photon whole body dose rate

Job Category	Year	Operation Phase	Hr/Yr	Relevant Nuclide	Skin: Hands & Forearms (mR/d)	Skin - Other (mR/d)	GSD	TBD Reference or Research Justification
Plant Floor High	1943	Operations	670	U234	2.11E+02	1.91E+01	5	Generic Metal TBD, Section 6.3
Plant Floor Low	1943	Operations	335	U234	1.06E+02	9.55E+00	5	Generic Metal TBD, Section 6.3
Supervisor	1943	Operations	33.5	U234	1.06E+01	9.55E-01	5	Generic Metal TBD, Section 6.3
Clerical	1943	Operations	0	U234	0.00E+00	0.00E+00	5	Generic Metal TBD, Section 6.3