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US Steel Co. National Tube Divison

CO.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. Where specific information is lacking, research into similar facilities described in the body of this Site Profile is used.

CO.2 Site Description

The National Tube Division of US Steel operated a steel mill and pipe manufacturing plant. While there was no information in the site research database concerning overall operations at this facility, there were reasonably detailed descriptions of the covered processes, i.e. the rotary piercing of uranium bars. The AWE work at this facility was experimental, carried out in two 2-week campaigns in 1959 and 1960.

Tests at the Christy Park Works, National Tube Division of the U. S. Steel Corporation, conducted in 1959 and 1960, demonstrated that rotary piercing of uranium was possible. The tests were conducted for National Lead of Ohio (Fernald).¹

CO.2.1 Site Activities

The AWE work at this site involved exclusively one study to explore the technique of rotary piercing for fabricating tubular fuel elements. The method tested involved rotary piercing a solid bar into a tubular section, and elongating and reducing the pierced section to a suitable size for machining to a hollow fuel element (machining the tubular elements was handled elsewhere under contract with National Lead Co.). Tests were run in two separate campaigns: April 14 – April 29, 1959 and February 17 – 26, 1960. In the first test, 11 billets were processed. The piercing was unsuccessful and another campaign was proposed. Modifications to the equipment included switching to a DC motor on the mill in order to permit slower and adjustable rolling speed. In the second test, 24 billets were successfully pierced. All equipment was completely decontaminated (the rollers were decontaminated by machining in the tool repair shop, to remove the outer contaminated layer). There was no residual contamination left at US Steel.

The AWE work at this facility was extremely limited and would have involved very few employees (likely less than 10, including supervision). The layout of the facility and the specific location of the AWE work conducted there, are not described in any available reference. It is therefore difficult to determine the likelihood that claimants were involved in the AWE work at this facility. Nevertheless, employees potentially exposed include those operating, inspecting, or repairing furnaces and rolling mill equipment, including tool and die makers, and pipe fitters. Crane operators, given their work location (above and throughout the facility), are also potentially exposed to airborne dust associated with the rotary piercing process.

CO.2.2 Job Categories

Table CO.2 assigns all US Steel, National Tube Division claimant job titles as of the effective date of this appendix to one of the following four Job Categories.

Plant Floor High (Involved directly in operations)
Plant Floor Low (Involved in support of operations)
Supervisor (Assumed to spend some time in the production areas)
Clerk (Assumed to have minimal exposure)

Claims forwarded to NIOSH by the Department of Labor after the effective date of this appendix will be evaluated during the dose reconstruction process to determine the most appropriate Job Category.

CO.3 Occupational Medical Dose

No information regarding occupational medical dose specific to US Steel, National Tube Division 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.

CO.4 Occupational Internal Dose

Limited air sampling and bioassay data were available from the second campaign (operations taking place between February 17 - 26, 1960), as well as bioassay data for uranium analysis of urine samples collected prior to and after the campaign. Ten individuals from US Steel, National Tube Division were monitored with bioassay, but the best available copy of the monitoring report is illegible for the names of the individuals.

As a first estimate of the Plant Floor High exposure level, daily weighted averages for both operators whose exposures were monitored (furnace and mill) were calculated by assuming exposures at measured BZ values persisted 4 hours per day, with the remainder of the day at exposure equal to the average GA level. This is a favorable assumption since the time required for complete processing of one billet averages less than 10 minutes (reference 10541, page 44), and a total of only 35 billets were processed during both campaigns (11 billets in the first campaign, and 24 in the second). The average of the two operator DWAs was assumed as the arithmetic mean of a lognormal distribution of plant floor high exposures. Given the nature of the work at this facility, intake estimates were then calculated based on limited exposure consisting of two 40-hour work weeks each in 1959 and 1960. Estimated intakes using this method were 13.2 pCi per day.

Intake estimates based on the uranium bioassay data were also evaluated using the IMBA internal dosimetry computer code. The twenty bioassay results are shown in Table CO.1:

Table CO.1. Urine bioassay data

	Sample Collection Date		Net Change (mg/l U)
	2/15/1960 (mg/l U)	3/17/1960 (mg/l U)	
Individual 1	0.006	0.003	-0.003
Individual 2	0.005	0.012	0.007
Individual 3	0.035	0.011	-0.024
Individual 4	0.006	0.016	0.010
Individual 5	0.007	0.015	0.008
Individual 6	0.005	0.008	0.003
Individual 7	0.006	0.007	0.001
Individual 8	0.005	0.014	0.009
Individual 9	0.005	0.012	0.007
Individual 10	0.008	0.008	0.000

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Only half the monitored individuals showed a significant increase in excreted uranium after the February 1960 campaign. However, because the bioassay results cannot be linked to an individual, the highest positive net change was used in the intake estimation as an assumption that is favorable to the claimant. The maximum individual net change (0.01 mg/L) converts to 9.9 pCi per day excretion. The resultant daily intake estimate obtained in this way was 3570 pCi per day assuming absorption of Class M compounds, and 123130 pCi per day assuming absorption of Class S compounds. These values are the daily intakes during the duration of the campaign.

The bioassay results from samples collected prior to the 1960 campaign are near levels observed in an unexposed population, and cannot be used to estimate intakes during the 1959 campaign. Doing so results in unrealistically high values. The 1960 intake estimates should therefore be used for both 1959 and 1960 even though the 1959 campaign processed only half as many billets.

Exposure to residual contamination is considered to be negligible since the work area and all equipment was reportedly decontaminated thoroughly after each of the 2-week tests was completed.

Tables CO.3 and CO.4 contain inhalation and ingestion intakes in terms of pCi per day for each job category and each year. The absorption class most favorable to the claimant should be assumed.

CO.5 Occupational External Dose

The site research database contains information related to external dose in the form of smear samples collected during the second campaign (Reference 10541, pg 30). The average of the smear sample results represents exposure from surfaces during each of the 2-week campaigns in 1959 and 1960.

The file also contains badge data (Reference 10541, pg. 49). The badges were worn by National Lead Co. employees who were on site to observe the experiments. The badges represent the entire external whole body dose associated with the work for each of the two campaigns, as they were worn for the 2-week duration of the test. It was assumed that the distribution of these dosimeter readings could be used to represent the supervisor job category, and the other three generic job category external exposures could be scaled from this value. It was assumed that this value would represent the exposure for one year.

Non-penetrating radiation doses were assigned using the assumptions of Section 6.3 of this TBD.

Tables CO.5 and CO.6 contain external doses for whole body (penetrating) and skin (non-penetrating).

CO.6 Residual Contamination

After each of the two campaigns, the work area and all equipment were thoroughly decontaminated and the decontamination was documented. Decontamination after each of the campaigns was documented and available for review in the site research database. Based on the discussion of the procedures followed, it is unlikely that there was residual contamination, either between the two campaigns or after the experiments were

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completed in March 1960. See reference 10541 (pages 99 and 25 for the 1st and 2nd campaigns respectively). Little potential exists for exposure to residual contamination².

CO.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. 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 CO.2. Job Categories for all current claimants who worked at US Steel, National Tube Division

Job Title	Exposure Category
Crane Operator	1
Crane Operator	1
Craneman/Electrician	1
Bricklayer	2
Peeler Repairman	2
Pipefitter	2
Pipefitter	2
Tool Engineer	2
Utilities Analyst	2
Inspector	3

Table CO.3. INTERNAL DOSE PATHWAYS - Inhalation of Airborne Radionuclides**Assumptions:**

Operational Period Maximum Intake Calculated from Bioassay Data: 9.9 pCi/day Uranium Urine Excretion

Residual Period Daily Weighted Average Air Concentration: 0 dpm/m³

TBD GSD Default is 5

Conversion Factor :2.22 dpm/pCi

Breathing Rate: 1.2 m³/hour

All intakes and doses assume full-time employment for the given year (intake during operations spread over calendar year).

Job Category	Year	Operation Phase	Hr/Yr	Relevant Nuclide	Absorption Class	Intake (pCi/d)	GSD	TBD Reference or Research Justification
Plant Floor High	1959-'60	Operations	80	U234	M	9.78E+01	5	Based on measured bioassay results
Plant Floor High	1959-'60	Operations	80	U234	S	3.37E+03	5	Based on measured bioassay results
Plant Floor Low	1959-'60	Operations	80	U234	M	4.89E+01	5	Based on measured bioassay results
Plant Floor Low	1959-'60	Operations	80	U234	S	1.69E+03	5	Based on measured bioassay results
Supervisor	1959-'60	Operations	80	U234	M	2.45E+01	5	Based on measured bioassay results
Supervisor	1959-'60	Operations	80	U234	S	8.43E+02	5	Based on measured bioassay results
Clerical	1959-'60	Operations	80	U234	M	2.45E+00	5	Based on measured bioassay results
Clerical	1959-'60	Operations	80	U234	S	8.43E+01	5	Based on measured bioassay results

Table CO.4. INTERNAL DOSE PATHWAYS - Ingestion of Airborne Radionuclides**Assumptions:**

Inhalation to Ingestion Ratio: 0.114 - see 3.5.2 TBD-6000

Job Category	Year	Operation Phase	Hr/Yr	Relevant Nuclide	Absorption Class	Intake (pCi/d)	GSD	TBD Reference or Research Justification
Plant Floor High	1959	Operations	80	U234	M	1.12E+01	5	Based on inhalation estimates
Plant Floor High	1960	Operations	80	U234	S	3.85E+02	5	Based on inhalation estimates
Plant Floor Low	1959	Operations	80	U234	M	5.58E+00	5	Based on inhalation estimates
Plant Floor Low	1960	Operations	80	U234	S	1.92E+02	5	Based on inhalation estimates
Supervisor	1959	Operations	80	U234	M	2.79E+00	5	Based on inhalation estimates
Supervisor	1960	Operations	80	U234	S	9.61E+01	5	Based on inhalation estimates
Clerical	1959	Operations	80	U234	M	2.79E-01	5	Based on inhalation estimates
Clerical	1960	Operations	80	U234	S	9.61E+00	5	Based on inhalation estimates

Table CO.5. EXTERNAL DOSE PATHWAYS - Whole Body**Assumptions:**Submersion Dose Conversion Factor: 2.462E-09 mrem/h/dpm/m³

Deposition velocity: 0.0008

Contaminated Surface Dose Conversion Factor: 5.615E-10 mrem/h/dpm/m²

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	1959	Operations	80	U234	1.98E+00	1.15	Based on external dosimeter readings of NLO observers
Plant Floor High	1960	Operations	80	U234	1.98E+00	1.15	Based on external dosimeter readings of NLO observers
Plant Floor Low	1959	Operations	80	U234	9.90E-01	1.15	Based on external dosimeter readings of NLO observers
Plant Floor Low	1960	Operations	80	U234	9.90E-01	1.15	Based on external dosimeter readings of NLO observers
Supervisor	1959	Operations	80	U234	4.95E-01	1.15	Based on external dosimeter readings of NLO observers
Supervisor	1960	Operations	80	U234	4.95E-01	1.15	Based on external dosimeter readings of NLO observers
Clerical	1959	Operations	80	U234	4.95E-02	1.15	Based on external dosimeter readings of NLO observers
Clerical	1960	Operations	80	U234	4.95E-02	1.15	Based on external dosimeter readings of NLO observers

Table CO.6. 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	1959	Operations	80	U234	2.52E+01	2.28E+00	5	Generic Metal TBD, Section 6.3
Plant Floor High	1960	Operations	80	U234	2.52E+01	2.28E+00	5	Generic Metal TBD, Section 6.3
Plant Floor Low	1959	Operations	80	U234	1.26E+01	1.14E+00	5	Generic Metal TBD, Section 6.3
Plant Floor Low	1960	Operations	80	U234	1.26E+01	1.14E+00	5	Generic Metal TBD, Section 6.3
Supervisor	1959	Operations	80	U234	1.26E+00	1.14E-01	5	Generic Metal TBD, Section 6.3
Supervisor	1960	Operations	80	U234	1.26E+00	1.14E-01	5	Generic Metal TBD, Section 6.3
Clerical	1959	Operations	80	U234	0.00E+00	0.00E+00	5	Generic Metal TBD, Section 6.3
Clerical	1960	Operations	80	U234	0.00E+00	0.00E+00	5	Generic Metal TBD, Section 6.3