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Dose Reconstruction
Project for NIOSH

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BAKER-PERKINS– MICHIGAN

P.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.

P.2 Site Description

Baker-Perkins in Saginaw, Michigan, manufactures commercial mixers (among other products). Documentation demonstrates that a limited quantity of radioactive material was used in a test process with its mixers at its laboratory facility (a single building). Controls were in place during the process and post-operational decontamination was implemented with radiological surveys having been performed. AWE period of performance was five days in May, 1956.

P.2.1 Site Activities

On May 14-15, 1956, Baker-Perkins performed a test of its mixing equipment for NLO (Fernald). The tests involved mixing approximately 1-2 drums of uranium trioxide (orange oxide) with water and kneading the mixture with the Baker-Perkins "P" and "K" Ko-Kneader machines. Decontamination of the equipment was conducted on May 15-18, 1956. The cleaning included chipping, power brushing and steaming. Air monitoring was conducted across the five day period (Reference #9505, page 10, 16-25).

P.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)
Grinder
Plant Floor Low (Involved in support of operations)
Assembler
Supervisor
Draftsman/tester
Clerk
None reviewed

P.3 Occupational Medical Dose

No information regarding occupational medical dose specific to Baker-Perkins--Michigan 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.

P.4 Occupational Internal Dose

Air monitoring data were found in the Site Research database relating to occupational internal dose during the five days of AEC work (Reference #9505, pages 16-25). Results

of both breathing zone (BZ) and general area (GA) monitoring for alpha radiation (alpha scintillation) were reported. The geometric mean and geometric standard deviation for BZ monitoring were 1,210 dpm/m^3 and 4.91 respectively. The corresponding values for the GA samples were 92 dpm/m^3 and 5.48. There are not sufficient data on monitoring duration to calculate time-weighted averages. Therefore, internal doses will use the geometric mean of the distribution of measured exposures to represent exposure over the entire day. Considering the nature of the work and the types of samples taken, a "plant floor high" exposure would be calculated as 50% BZ and 50% GA exposure levels. "Plant floor low" would be calculated as 25% BZ and 75% GA exposure levels, while a "supervisor" would be 100% GA exposure. The "clerk" exposure would be 10% of the "supervisor" exposure.

Tables P.1 and P.2 present these internal dose estimates in pCi per calendar day to be used for each calendar year listed. The table values should be multiplied by 73 to calculate internal dose estimates for a single day of the 5 day exposure period.

P.5 Occupational External Dose

No external dose readings were reported in the Site Research database related to occupational external dose during the five days of AEC work. However, it was reported that "at least one, but no more than two 'drums' of orange oxide are believed to have been used in the tests" (Reference #9505, page 10). Thus external dose could be calculated assuming a distance of five feet from two drums of orange oxide, or by the external dose from air concentrations of orange oxide associated with the alpha radiation levels reported in P.4.

Alternatively, the Uranium Refining TBD external exposure for either "boildown and denitration" or "oxide reduction-tray furnace" operations could be used. Either of these exposures would be very favorable to the claimant as they are based upon industrial rather than experimental process volumes.

Tables P.3 and P.4 present these external dose estimates in mrem per calendar day to be used for each calendar year listed. The table values should be multiplied by 73 to calculate external dose estimates for a single day of the 5 day exposure period.

P.6 Residual Contamination

Documentation reviewed indicates that there is little potential for significant residual contamination outside of the period in which weapons-related production occurred.

P.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

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

Assumptions:
Operational Period Daily Weighted Average Air Concentration, Plant Floor High: 1210 dpm/m^3, GSD: 4.84
General Area Air Concentration: 92 dpm/m^3, GSD: 5.5
TBD GSD Default is 5
Conversion Factor: 2.22 dpm/pCi
Breathing Rate: 1.2 m^3/hour
All intakes and doses assume full-time employment for the given year.
Intakes are the geometric mean of a lognormal distribution

Job Category	Year	Operation Phase	Hr/Yr	Relevant Nuclide	Intake (pCi/d)	GSD	TBD Reference or Research Justification
Plant Floor High	1956	Operations	40	U234	3.15E+01	5.5	50% BZ + 50% GA (see text): GSD Max of BZ and GA
Plant Floor Low	1956	Operations	40	U234	1.73E+01	5.5	25% BZ + 75% GA (see text): GSD Max of BZ and GA
Supervisor	1956	Operations	40	U234	5.45E+00	5.5	100% GA (see text)
Clerical	1956	Operations	40	U234	5.45E-01	5.5	10% GA (see text)

Table P.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 and 8.5.3 TBD-6001
Deposition velocity: 0.00075 m/s
Resuspension Factor: 1.00E-06 1/m
Intakes are the geometric mean of a lognormal distribution

Job Category	Year	Operation Phase	Hr/Yr	Relevant Nuclide	Intake (pCi/d)	GSD	TBD Reference or Research Justification
Plant Floor High	1956	Operations	40	U234	2.94E-01	5.5	50% BZ + 50% GA (see text): GSD Max of BZ and GA
Plant Floor Low	1956	Operations	40	U234	1.61E-01	5.5	25% BZ + 75% GA (see text): GSD Max of BZ and GA
Supervisor	1956	Operations	40	U234	5.08E-02	5.5	100% GA (see text)
Clerical	1956	Operations	40	U234	5.08E-03	5.5	10% GA (see text)

Table P.3 EXTERNAL DOSE PATHWAYS - Whole Body

Assumptions:
Submersion Dose Conversion Factor: 2.462E-09 mrem/h/dpm/m^3
Deposition velocity: 0.00075 m/s
Contaminated Surface Dose Conversion Factor: 5.615E-10 mrem/h/dpm/m^2
All external dose from estimated exposure to Uranium Nitrate Drums
Residual period: Assume no handling of U metal - only exposure is from residual contamination on floor and in air
Dose in the table is the geometric mean of a lognormal distribution

Job Category	Year	Operation Phase	Hr/Yr	Relevant Nuclide	External Whole Body (mR/d)	GSD	TBD Reference or Research Justification
Plant Floor High	1956	Operations	40	U234	1.28E+00	5	Generic Refining TBD, Table 7.1 (Boildown and Denitration)
Plant Floor Low	1956	Operations	40	U234	1.27E+00	5	Same
Supervisor	1956	Operations	40	U234	1.26E+00	5	Same
Clerical	1956	Operations	40	U234	4.08E-04	5	Same

Table P.4 EXTERNAL DOSE PATHWAYS - Skin

Assumptions:
All assumptions from TBD-6000 Section 6.3
Operational Period: Non-penetrating dose to skin 9.0 mR/hour (hands and forearms) 2.65 mR/hour (other)
Plant Floor High: Assume hands in contact with material 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 material
Clerical: assume no handling of U.
Residual Period: No Residual Period
Dose in the table is the geometric mean of a lognormal distribution

Job Category	Year	Operation Phase	Hr/Yr	Relevant Nuclide	Hands & Forearms (mR/d)	Other Skin (mR/d)	GSD	TBD Reference or Research Justification
Plant Floor High	1956	Operations	40	U234	9.86E-01	2.90E-01	5	Generic Refining TBD, Section 7.1 (Boildown and Denitration)
Plant Floor Low	1956	Operations	40	U234	4.93E-01	1.45E-01	5	Same
Supervisor	1956	Operations	40	U234	4.93E-02	3.63E-02	5	Same
Clerical	1956	Operations	0	U234	0.00E+00	0.00E+00	5	Same