Carborundum Company Special Exposure Cohort Petition Evaluation Report

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EEOICPA Facility Listing

- Carborundum Company
  - State: New York Location: Niagara Falls
  - Atomic Weapons Employer (AWE)
    1943-1944, 1959-1967
  - Residual Radiation
    1945-1958, 1968-1992

EEOICPA Facility Listing

- Carborundum Facility Description:

  In 1943 and 1944 the Carborundum Company at its Globar Plant and Buffalo Avenue locations was engaged in various phases of Manhattan Engineer District (MED) programs to determine suitable methods for engineering and shaping uranium rods. This work also involved the forming, coating, and canning of uranium rods for the MED pile.

EEOICPA Facility Listing

- Facility Description, cont.:
  - From 1959 through 1967 the company manufactured uranium and plutonium carbide pellets for an AEC research program
  - Carborundum also performed work during the 1950s that is not covered under EEOICPA

SEC Petition Overview

- Petition received November 19, 2014
- Petitioner requested class definition:

  All employees who worked in any area of the Carborundum Company facility on Buffalo Avenue, Niagara Falls, NY from January 1, 1943 through December 31, 1976

SEC Petition Overview

- Qualified for evaluation on February 2, 2015
- Basis for Qualification:

  Radiation exposures and radiation doses potentially incurred by members of the proposed class were not monitored either through personal monitoring or through area monitoring

Petition Evaluation Report

- Class Evaluated by NIOSH:

  All employees who worked in any area of the Carborundum Company facility on Buffalo Avenue, Niagara Falls, NY from January 1, 1943 through December 31, 1976.

- SEC Petition Evaluation Report completed by NIOSH on May 26, 2015. Revision 1 issued June 3, 2015 to correct the date and document number of a reference.

- NIOSH recommended class: None

Previous Dose Reconstructions

Total claims submitted for dose reconstruction	120
Cases submitted for energy employees who worked during the period under evaluation (1/1/1943 – 12/31/1976)	106
Number of dose reconstructions completed for energy employees who worked during the period under evaluation	90
Cases for which internal dosimetry records were obtained	0
Claims for which external dosimetry records were obtained	0

Sources of Available Information

- NIOSH Site Research Database: 220 documents researched
- Site Profile Batelle-TBD-6000
- ORAUT-OTIB-0070, Dose from Residual Contamination
- Seven former workers interviewed, all post 1950 timeframe
- DCAS and ORAUT Technical Information Bulletins
- Standard data searches also conducted

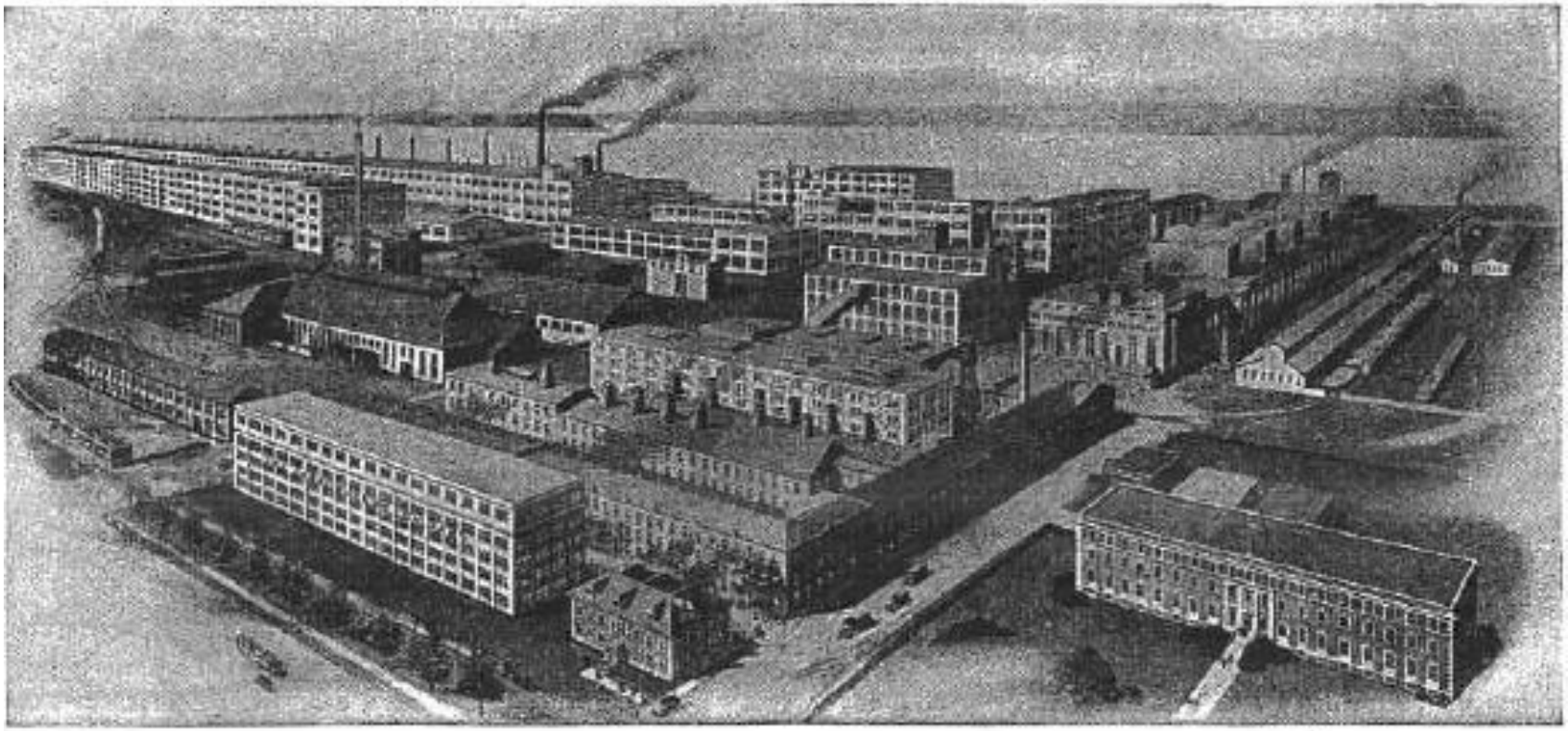
Carborundum Company Background

- The Carborundum Company was located at 1920 Buffalo Avenue
- Two AWE operational periods and two residual contamination periods:
  - First Operational Period: 1943-1944
  - First Residual Period: 1945-1958
  - Second Operational Period: 1959-1967
  - Second Residual Period: 1968-1976

Carborundum Company Background

- Company founded in 1891 to produce silicon carbide abrasives
- Company moved to Niagara Falls in 1895
- Diversified and expanded internationally over the years
- Employed approximately 6,000-7,000 employees during the 1940s
- Estimated to have 30 to 50 buildings on site

Carborundum Plant, Buffalo Avenue



Main Offices and Plant, The Carborundum Company, Niagara Falls, N. Y.

Carborundum Company Background

- Location of 1943 AEC work unknown
- Research and Development Building (Building 1) was opened in 1953
- Building 1 was the location of uranium and plutonium work in 1957 – 1968
- Building 1 was a four-story building comprising over 60,000 square feet

First AWE Period Scope of Work

- Experimental centerless grinding performed in June 1943 in support of the uranium slug fabrication program coordinated by DuPont
- Purpose was to determine type of abrasive wheel and optimal speeds for grinding uranium slugs with a centerless grinder
- No purchase order issued and no medical supervision considered necessary

First AWE Period Scope of Work

- Work limited to testing centerless grinding
- Pilot production centerless grinding performed by other companies
- Total quantity of uranium at Carborundum:
  10 uranium metal slugs totaling 30 pounds
- Uranium slugs received June 1, 1943
- Uranium returned shipped September 27, 1943

First AWE Period Work Process

- Tested four different abrasive wheels, one of which was effective
- Determined optimal speeds and machine settings
- Grinding was done on the ten slugs in June 1943
- Results reported to DuPont on July 2, 1943
- Uranium slugs returned September 27, 1943

First AWE Period Exposures

- Internal dose from grinding uranium metal
- External dose from handling uranium metal
- No monitoring records are known to exist
- Dose from centerless grinding activities is presumed for the entire period uranium metal was on site: June 1 through September 27, 1943

First AWE Period Internal Dose

- Uranium intakes
  - TBD-6000 inhalation intakes for centerless grinding presumed to bound intakes for experimental grinding at Carborundum
  - Intakes are based on air concentrations from centerless grinding without ventilation
  - Allows for intakes from resuspension during down time between setups and cleanup of equipment
  - Ingestion rate estimated from air concentrations

First AWE Period Internal Dose

- Uranium intakes
  - Surrogate data: TBD-6000 intakes are from production operations at other sites a few years later
  - Justification for using TBD-6000:

    Source term lower than the TBD-6000 sites

    Same process—the air concentration in TBD-6000 is centerless grinding without ventilation

    Reports indicate the grinding was not continuous

First AWE Period External Dose

- Dose from exposure to photons and electrons
  - TBD-6000 Table 6-4 dose rates from machining for the pre 1951 era
  - Justification for use: uranium metal dose rate estimates in TBD-6000 are applicable to the uranium metal slugs that were sent to Carborundum
  - Dose applied as prescribed in TBD-6000 for June through September 1943

Centerless Grinding Residual Contamination 1943-1958

- Dose from residual uranium contamination after slugs shipped out September 27, 1943
- No available records on decontamination of equipment or area
- Contamination levels from settling of airborne particulates derived as specified in TBD-6000, with subsequent resuspension

Centerless Grinding Residual Contamination 1943-1958

- ORAUT-OTIB-070 methods used to estimate annual inhalation intakes and source term depletion
- External dose from residual contamination based on derived contamination levels and dose coefficients in Federal Guidance Report No. 12

Second AWE Period, 1959-1967

- Carborundum was an AEC contractor and subcontractor
- Seven contracts that involved reactor fuel development
- Developed methods to synthesize fuels for breeder reactors

Second AWE Period, 1959-1967 Scope of Work

- Two AEC contracts
  - Initial contract in 1959-1961 was for synthesis of uranium refractory compounds UN, UC, and U_3Si_2 for study as reactor fuel
  - Contract in 1966-1967 to study an alternate method to synthesize mixed U/Pu carbide fuels
  - Related to subcontracts with United Nuclear from 1959 through 1965

Second AWE Period, 1959-1967 Scope of Work

- Five subcontracts 1959-1965 under United Nuclear, the AEC prime contractor
  - AEC Fuel Development program
  - Mixed uranium/plutonium carbide fuel to study more economical fuels for fast breeder reactors
  - United Nuclear responsible for design, fuel irradiation and evaluation
  - Carborundum responsible for fuel fabrication

Second AWE Period, 1959-1967
Work Area

- Work was performed in Building 1 which opened in 1953
- New building had experimental high-temperature furnaces, electron microscopes, X-ray installation, gloveboxes, other equipment
- Layout of uranium work areas not available
- Plutonium facility was constructed and became operational in 1961

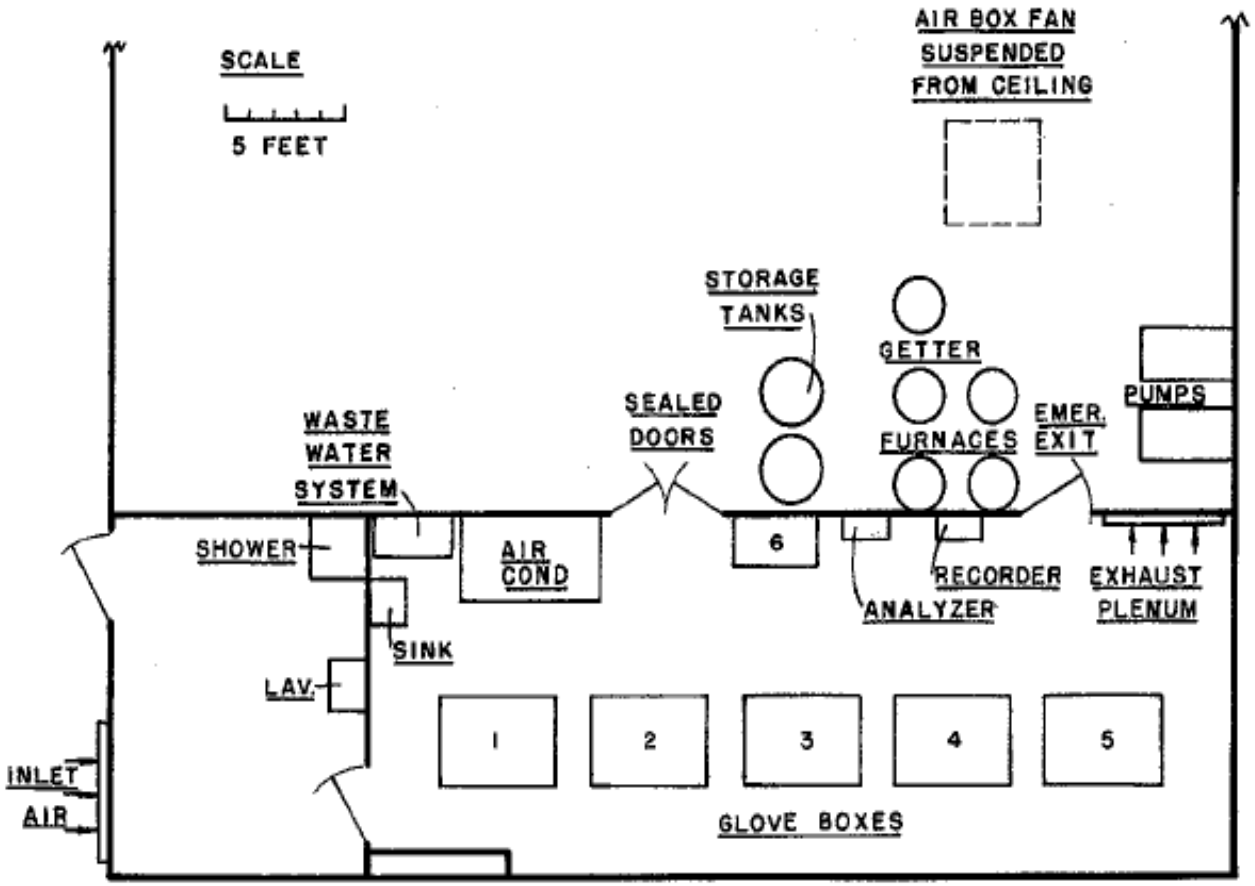
Second AWE Period, 1959-1967
Work Area

- Plutonium facility
  - In the Central Laboratory, 4th floor of Building 1
  - 15 feet by 48 feet by 8.5 feet high
  - Enameled, steel paneled walls and ceiling with vinyl floor
  - Included work space (15 ft by 37 ft) and a change room (11 ft by 15 ft)
  - Fully contained and ventilated work areas

Second AWE Period, 1959-1967
Work Area

- Plutonium facility had six glove boxes
  - All at atmospheric pressure; three with helium, three with air atmospheres
  - Constructed of welded aluminum plate with full side safety-plate glass windows
  - Materials moved into or out of the boxes by the pouching technique, or directly through the O-ring-sealed sliding door of #1 box, which was maintained at a low level of contamination

Plutonium Work Area



Second AWE Period, 1959-1967
Work Process

- Initial uranium work 1959 - 1961
  - Objective to develop uranium refractory compounds as economical alternative to UO_2 for reactor fuel
  - Develop methods to synthesize UN, UC, and U_3Si_2
  - Fabricate into bodies suitable for testing
  - Determine physical properties of the materials

Second AWE Period, 1959-1967
Work Process

- Initial uranium work 1959 - 1961
  - Uranium combined with reactant, such as carbon, nitrogen, or silicon
  - Experiments with different compounds and reactions
  - Involved dry ball-milling and pressing into pellets
  - Experimented with cold pressing, hot pressing, and sintering methods
  - Experimented with furnace types, atmospheres, and temperatures to produce the chemical reactions

Second AWE Period, 1959-1967
Work Process

- Testing of synthesized uranium refractory compounds 1959 - 1961
  - Thermal expansion and density measurements
  - Thermal conductivity
  - Modulus of rupture
  - Other physical properties
  - X-ray analysis

Second AWE Period, 1959-1967
Work Process

- Initial uranium work 1959 - 1961
  - Produced many batches of uranium monocarbide ranging from 30 grams to 6 pounds
  - Quantities of uranium mononitride and uranium silicide unknown
  - Work controls unknown but work was reported suspended for a period while a glovebox was replaced

Second AWE Period, 1959-1967
Plutonium Work Process

- Plutonium Work 1960 - 1965
  - Develop economic method to produce high density uranium-plutonium monocarbide (UPu)C fuel pellets
  - Produce fuel pellets to substitute in the core of the Fermi Fast Breeder Reactor for testing fuel characteristics and cost as compared to mixed oxide fuels
  - Carborundum only involved with the fuel development and fabrication

Second AWE Period, 1959-1967
Plutonium Work Process

- Plutonium Work 1960 - 1965
  - Work performed in new Pu facility
  - Facility initially tested with UC
  - First shipment of plutonium arrived in 1960
  - Pu processing started in March 1961
  - Mass ratio of U/Pu carbide fuel was 95% U/5% Pu or 80% U/20% Pu

Second AWE Period, 1959-1967
Plutonium Work Process

- Fabrication process, 1961 - 1965:
  - Work performed in gloveboxes
  - Batch work with mass restrictions
  - Mixed U and Pu oxide powders with carbon
  - Ball milling of mixture
  - Heating mixture to form monocarbide clinker

Second AWE Period, 1959-1967
Plutonium Work Process

- Fabrication process, 1961 - 1965:
  - Crush clinker to fine powder
  - Cold press and sinter to a dense form
  - Grind pellets
  - Inspect and ship

Second AWE Period, 1959-1967
Plutonium Work Process

- Other work with the fuel:
  - Explore fuel synthesis methods
  - Evaluate physical properties of pellets
  - Density measurements
  - X-ray diffraction analysis

Second AWE Period, 1959-1967
Plutonium Work Process

- 1966 - 1967 work:
  - Six month contract with the AEC to study alternate method to synthesize (UPu)C
  - Experiments for coprecipitation of the compound from a mixture of U and Pu nitrate solutions

Second AWE Period, 1959-1967 Monitoring Data

- Internal dose
  - Although interviewees stated that they provided bioassay samples, no bioassay results have been located
  - No contamination surveys have been located
  - Air samples results are available from uranium work in 1959 and 1961
  - Air samples from plutonium work in 1961 are available

Second AWE Period, 1959-1967 Monitoring Data

- External dose
  - NIOSH has not identified any dosimetry data or external dose rate measurements

Second AWE Period, 1959-1967
Air Sampling Data

- Uranium: general area air dust samples were taken in November 1959 and April 1961
  - Nine are legible in the documentation
  - All nine air sample results were positive
  - Highest result was 6 dpm per cubic meter from the furnace room

Second AWE Period, 1959-1967
Air Sampling Data

- Plutonium: sixteen air samples taken in June and April 1961
  - Six were breathing zone samples

    Three were positive

    Highest was 0.76 alpha dpm per sample
  - Ten were general area samples

    Nine were positive

    Highest was 22 alpha dpm per sample

Second AWE Period, 1959-1967
Internal Dose Estimates

- Air sample data used to estimate intakes from uranium work and from plutonium work
- For uranium, the 95th percentile of the general area air samples used to estimate intakes by support workers, with operator intakes assumed to be double
- For plutonium, both general area and breathing zone sample results are available to estimate intakes

Second AWE Period, 1959-1967
External Dose Estimates

- For uranium work, TBD-6000 doses for machining uranium will be used to bound external dose
  - Use graded approach for levels of exposure
  - Photon and electron doses apply; neutron dose not applicable
  - Era of work is consistent with data from TBD-6000
  - The surrogate external uranium dose data from production facilities should bound external dose rates from exposure to the relatively low quantities of uranium compounds used at Carborundum

Second Residual Period, 1959 - 1976 Internal Dose Estimates

- Dose from residual uranium contamination after end fuel fabrication ended in 1958
- No available records on decontamination of equipment or area
- Contamination levels from settling of airborne particulates derived as specified in TBD-6000, with subsequent resuspension

Second Residual Period, 1959 - 1976 Internal Dose Estimates

- ORAUT-OTIB-070 methods used to estimate annual inhalation intakes and source term depletion
- External dose from residual contamination based on derived contamination levels and dose coefficients in Federal Guidance Report No. 12

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Feasibility Summary

1943-1944 and 1958-1967 (operational periods) 1945-1958 and 1968-1976 (residual periods)		
Source of Exposure	**Feasible**	**Not Feasible**
Internal	Yes	
External	Yes	