SEC-00253 – Reduction Pilot Plant

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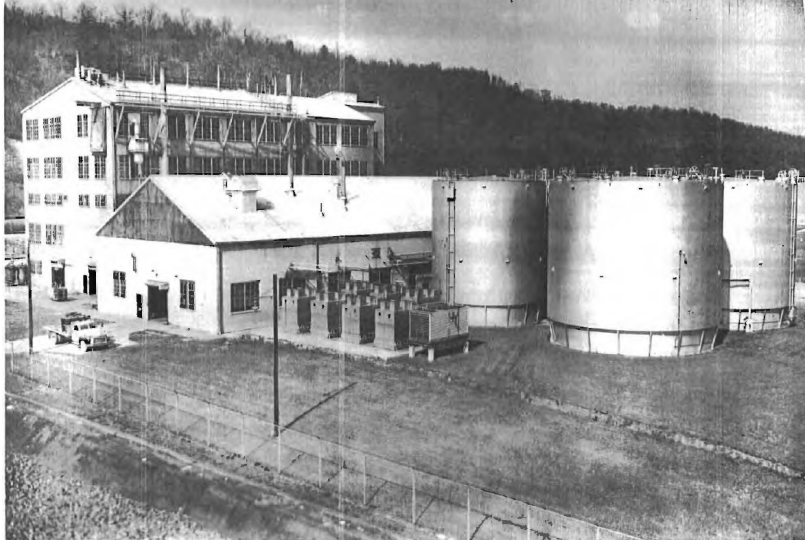
Presentation Overview

- Site and SEC Petition Overview
- Site Information
- Reduction Pilot Plant (RPP) Operations
- Dose Reconstruction Methods for the Evaluated Class
- Dose Reconstruction Feasibility Summary

Site and SEC Petition Overview

Reduction Pilot Plant



SRDB 85876, p.3

- Huntington, West Virginia
- Operated by International Nickel Company (INCO)
- Manufactured nickel powder for use in gaseous diffusion plants
- DOE Facility: 1951 – November 26, 1978
  Remediation: November 27, 1978 – May 18, 1979
- Remediation Contractor: Cleveland Wrecking Company

INCO Operations

- The RPP was 3.47 acre fenced area adjacent to INCO's large nickel plant in Huntington, West Virginia
- The facility was built and operated by INCO starting in 1951
- Security clearances were required
- Operations included use of low enriched uranium-contaminated nickel scrap supplied by the Department of Energy (DOE)
- Facility placed in Standby in 1963; demolished in 1978-1979

Petition SEC-00253

- Received June 25, 2019
- Requested SEC class:
  All INCO security personnel who worked at any location within the Reduction Pilot Plant during the period from June 7, 1976 through November 26, 1978
- The requested SEC class is within the Standby period
  - The Standby period was not a covered period under EEOICPA when the petition was received

Petition SEC-00253, continued

- July 31, 2019: NIOSH asked DOL to review petitioner's claim that the Standby period should be covered under EEOICPA
  - During Standby, INCO was under contract for maintenance and security
- November 15, 2019: DOL notified NIOSH that the Standby period was being added to the DOE facility time period
- Petition qualified for review on December 13, 2019 on the basis that NIOSH had no radiation exposure records for the requested class

Evaluation Report (ER)

- NIOSH Evaluated Class:
  All International Nickel Company (INCO) security personnel who worked at any location within the Reduction Pilot Plant during the period from June 7, 1976 through November 26, 1978
- NIOSH approved the ER on April 24, 2020
- NIOSH feasibility determination: dose reconstructions can be completed with sufficient accuracy for all members of the evaluated class

Site Information

Data Sources

- Site Profile Documents
  - *Technical Basis Document for the Huntington Pilot Plant, Huntington, West Virginia*, DCAS-TKBS-0004
  - *Site Profiles for Atomic Weapons Employers that Worked Uranium Metals*, Battelle-TBD-6000
  - *K-25 Gaseous Diffusion Plant – Occupational Internal Dose*, ORAUT-TKBS-0009-5

Claims in NIOSH DCAS Claims Tracking System (NOCTS) as of March 17, 2020

Description	Totals
Total number of claims submitted for dose reconstruction for employment at the RPP (92 submitted, 15 pulled by DOL)	77
Total number of dose reconstructions completed for the site (77 draft dose reconstructions completed with 76 final dose reconstructions submitted to DOL and 1 administratively closed)	76
Total number of claims submitted for energy employees who worked during the period under evaluation (June 7, 1976 through November 26, 1978)	42
Total number of claims submitted for energy employees who started their employment during the period under evaluation (June 7, 1976 through November 26, 1978)	4
Number of claims for which internal dosimetry records were obtained for the time period in the evaluated class definition	0
Number of claims for which external dosimetry records were obtained for the time period in the evaluated class definition	0

Other Sources of Information

- Documents and affidavits from petitioner
  - INCO security personnel made daily entries in the RPP during the evaluated period
  - Workers were not monitored for radiation exposure
- Interview with former worker
  - Workers entered the facility during the evaluated period and were not monitored for radiation exposure

Other Sources of Information, continued

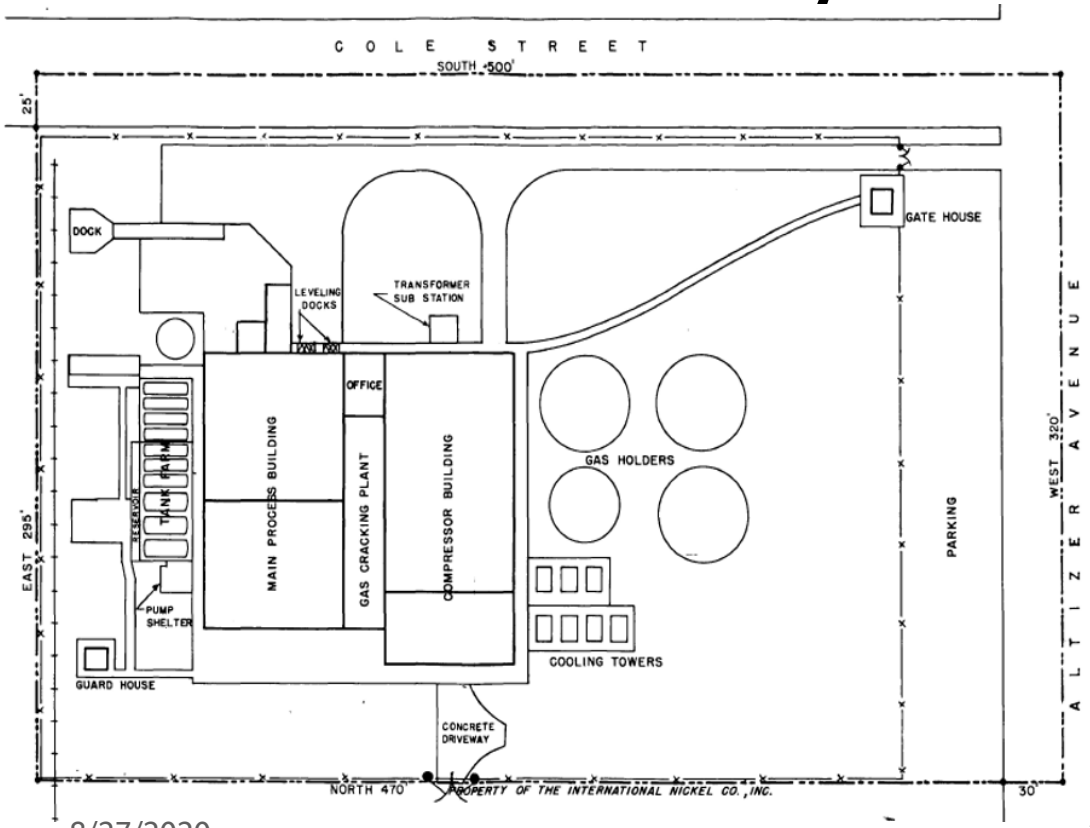
- NIOSH Site Research Database (SRDB)
  - Existing documents in the SRDB had process information on production operations and post demolition radiation data, but no data from the Standby period
- Extensive search for additional data was performed
  - NIOSH obtained additional information from the DOE, including radiological survey data from the Standby period

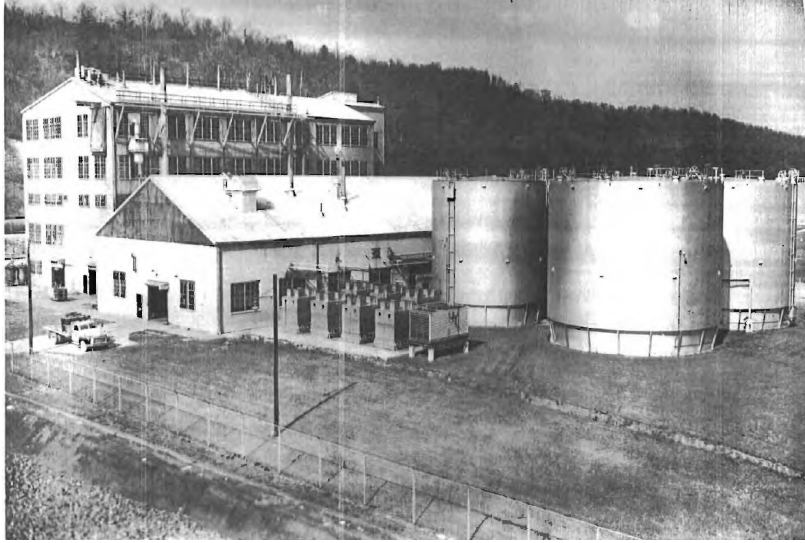
RPP Operations

RPP Operating History

- Employed 20 to 25 people during production period
- Facility consisted of a process building, a compressor building, and storage tanks
- Initially used nickel oxide supplied by INCO as the starting material to produce pure nickel powder
- Contaminated nickel scrap from DOE introduced as starting material in 1956

Reduction Pilot Plant Layout





SRDB 85876, p.3

SRDB 179705, p.40

Mond Process

1. Nickel oxide is combined with hydrogen gas to produce nickel metal and water: $NiO + H_2 \Rightarrow Ni + H_2O$

2. The metal is then combined with carbon monoxide to produce nickel carbonyl gas: $Ni + 4*CO \Rightarrow Ni(CO)_4$

3. Finally, the nickel carbonyl gas is distilled to separate any contaminants and then heated, causing it to decompose into pure nickel and carbon monoxide: $Ni(CO)_4 \Rightarrow Ni + 4*CO$

Radiological Exposure Sources

- Nickel scrap, including contaminated barrier material, used as starting material beginning in 1956
  - Previously used at the gaseous diffusion plants
  - Contaminated with no more than 0.0875 grams per pound of U-235 and no more than 500 ppm total uranium
  - Some barrier material had been used to enrich reprocessed fuel and contained “minute quantities” of Pu^{239}, Pu^{240}, Pu^{241}, U^{236}, Th^{232}, Np^{237}, U^{237} and Tc^{99}

Radiological Exposure Sources, continued

- Uranium does not form a carbonyl compound; it is removed in Step 2
- All uranium fell out as a fine dust in the ash receivers of the CO reactors
- The ash from Step 2 was vacuum transferred to a residue handling system
  - Passed through cyclone, metallic, and then bag filters
  - Drummed and shipped to Oak Ridge

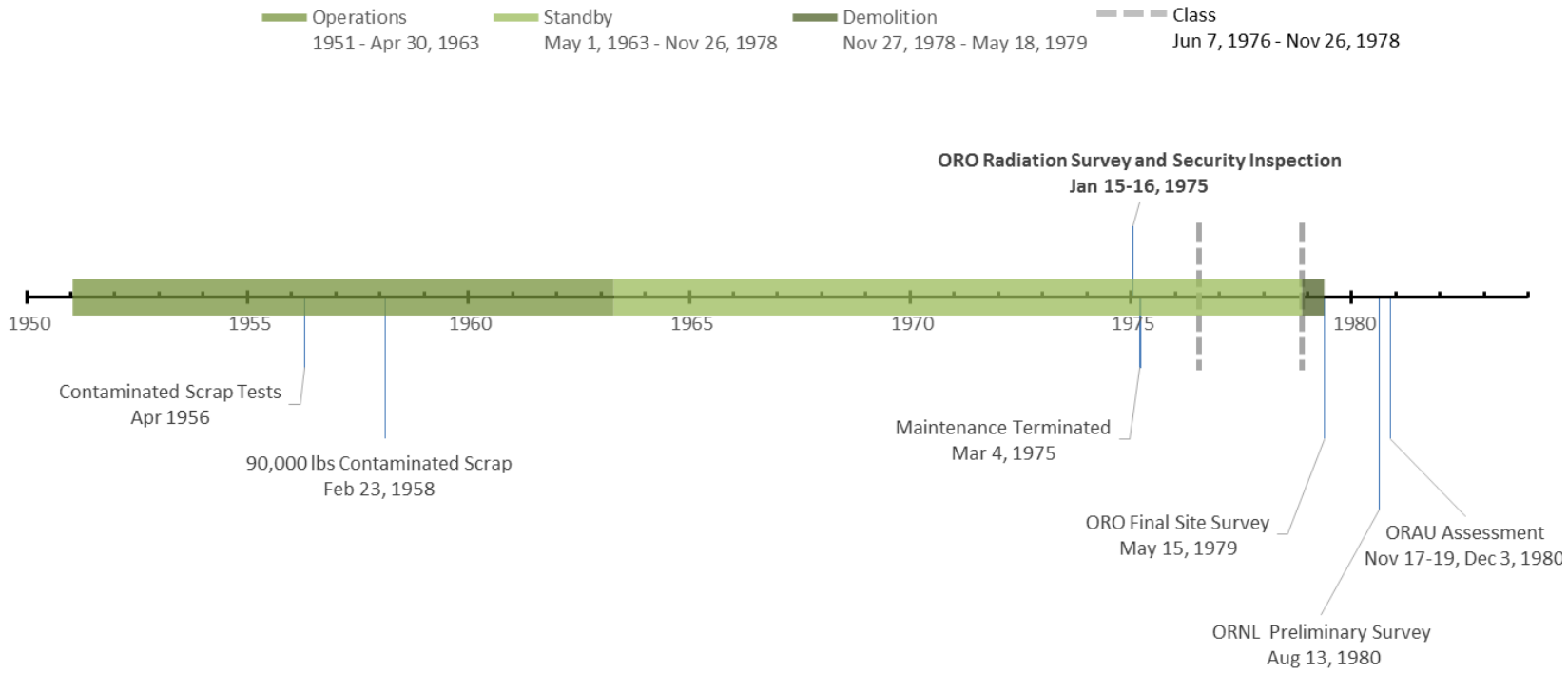
Standby Period

- Operations end and facility placed in Standby on May 1, 1963
  - All accessible source materials and residue ash were removed from the system
  - INCO contracted to perform routine maintenance, security, and inspections
- A radiation survey and a security inspection was performed January 15-16, 1975
- All building maintenance terminated March 4, 1975

Demolition

- Process Building demolished between November 27, 1978 and May 18, 1979
  - Cleveland Wrecking Company removed 59 truckloads and 4 railcar loads
  - Sent to DOE for disposal due to the possible presence of classified materials and nickel carbonyl
- Final Site Radiation Survey, Oak Ridge Operations, May 15, 1979
- Preliminary Radiological Survey, ORNL, August 13, 1980
- Radiological Assessment, ORAU, November 17–19 and December 3, 1980

Timeline


Operations
1951 - Apr 30, 1963
Standby
May 1, 1963 - Nov 26, 1978
Demolition
Nov 27, 1978 - May 18, 1979
Class
Jun 7, 1976 - Nov 26, 1978
ORO Radiation Survey and Security Inspection
Jan 15-16, 1975
1950
1955
1960
1965
1970
1975
1980
Contaminated Scrap Tests
Apr 1956
90,000 lbs Contaminated Scrap
Feb 23, 1958
Maintenance Terminated
Mar 4, 1975
ORO Final Site Survey
May 15, 1979
ORAU Assessment
Nov 17-19, Dec 3, 1980
ORNL Preliminary Survey
Aug 13, 1980

Dose Reconstruction Methods for the Evaluated Class

Radiation Exposures

- Internal exposure
  - Alpha dose from uranium
  - Recycled uranium contaminants
- External exposure
  - Photon dose
  - Beta dose
  - Neutron dose: no significant radiation
  - Medical X-rays: assumed required

Radiation Survey and Security Inspection Oak Ridge Operations, January 15-16, 1975

- Alpha contamination readings
  - Contact readings, highest at 960 DPM/100 cm^2
  - Smears, highest at 19 DPM/100 cm^2
- Gamma dose rate readings
  - 3 feet above floor
  - No difference from background, 8-10 µR/hr
- Beta-gamma dose rate readings
  - Contact readings, highest at 0.25 mR/hr
  - Smears, no activity detected

Radiological Assessment
ORAU, November 17–19 and December 3, 1980

- Measurements inside and outside of buildings
- Gamma
  - At contact with ground or floor surface, highest at 45 µR/hr
    - Gravel sampled, elevated Ra-226
    - ORNL Survey (August 13, 1980) also had reported 45 µR/hr at contact in the same area
  - 3 feet above ground, highest at 35 µR/hr
    - Compressor Building
    - Concrete block sampled, elevated Ra-226

Estimating Internal Dose From Uranium

- Assumptions
  - Alpha activity was due to uranium only
  - The maximum swipe result, 19 DPM/100 cm^2 used to estimate airborne radioactivity from contamination
  - Once per shift RPP security inspection 15 minutes per day for 365 days per year or 91.3 hours/year
  - 1.2 m^3 per hour breathing rate
  - 10^{-6}/m resuspension factor

19 dpm/100 cm^2 * 10000 cm^2/m^2 * 10^{-6} m^{-1} * 1.2 m^3/hr * 91.3 hr/yr = 0.208 dpm/yr

Estimating Internal Dose From Reprocessed Fuel Contaminants

- *K-25 Gaseous Diffusion Plant-Occupational Internal Dose*, ORAUT-TKBS-0009-5
  - Table 5-6, Default Isotopic Distribution
  - For low enriched uranium
  - Used to develop ratios of uranium activity : radionuclide activity

Radionuclide	dpm/g U
Pu-239	150,000
Am-241	150,000
U-236	2067
U-235	97,555
U-234	1,560,000
U-238	750,000
Np-237	142,000
Th-230	42,000
Tc-99	267

Inhalation Intakes

Radionuclide	Annual inhalation (dpm/year)
Uranium	0.208
Pu-239	0.0130
Am-241	0.0130
Np-237	0.00104
Th-230	0.00363
Tc-99	0.000023

Estimating External Photon Dose

- 8-10 µR/hr (0.008-0.010 mR/hr) gamma dose rate at 3 feet above surface, in Process Building, ORO survey, January 15-16, 1975
- Highest gamma reading at contact was 45 µR/hr (0.045 mR/hr), on driveway, ORNL, August 13, 1980 / ORAU, November 17-18 and December 3, 1980
- Highest gamma reading at 3 feet above ground was 35 µR/hr (0.035 mR/hr), in Compressor Building, ORAU, November 17-18 and December 3, 1980

0.035 mR/hour * 91.3 hours per year = 3.2 mR/year

Estimating External Beta Dose

- January 15-16, 1975 Survey
  - 41 swipes taken, no beta-gamma activity detected
  - 16 beta-gamma readings taken at contact, highest at 0.25 mR/hr
    - Found on equipment in the Process Building
- Assumptions
  - Result was due to beta activity from uranium progeny
  - Bounding beta dose rate

0.25 mrad/hour * 91.3 hours/year = 23 mrad/year

Dose Reconstruction Feasibility Summary

Summary of Feasibility Findings

Source of Exposure	Reconstruction Feasible (Yes or No)
Internal (enriched uranium)	Yes
Internal (recycled uranium contaminants)	Yes
External (gamma, beta)	Yes
External (neutron)	N/A
External (occupational medical x-ray)	Yes

Questions?