Kansas City Plant
Special Exposure Cohort Petition Evaluation Report

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Overview

- Received March 12, 2013
- Petitioner requested class definition
  - All Bannister Federal Complex employees who worked at the Bannister Federal Complex from 1949 to present
- Qualified July 1, 2013
  - Basis – Radiation exposures and doses potentially incurred by members of the proposed class were not monitored either through personal or area monitoring

Overview – continued

- NIOSH-designated Evaluation Report (ER) start date consistent with the start of AEC operations
- Examined 160 claims with employment 1994 or later to coincide with KCP's implementation of 10 CFR 835 to determine evaluation period end date
- NIOSH found no apparent and potentially inadequately-monitored exposures for post-1993

NIOSH-evaluated class

All employees who worked in any area of the Kansas City Plant in Kansas City, MO, from January 1, 1949 through December 31, 1993

Background

- Main Manufacturing Building main structure
  - About 2.7 million square feet of contiguous space
  - Houses the primary KCP manufacturing operations

Background – continued

- From the start principal operation to make non-nuclear components of nuclear weapons
  - Machining and fabrication of metals and plastics, plating, microelectronics, and electrical and mechanical assembly
- Currently makes about 85% of the non-nuclear components for the U.S. atomic stockpile

Background – continued

- Natural uranium work
  - Machined uranium slugs, handled uranium billets and ingots from February 1951 to December 1952
  - Performed this work in the Main Manufacturing Building (Department 49X)
  - Total of 313,070 lbs machined into slugs
  - Capacity to produce 1,000 slugs per day

Background – continued

- **Natural uranium work (cont.)**
  - **Inspected and assembled uranium components from May 1950 to February 1955 in the Main Manufacturing Building (Department 3A)**

Background – continued

- **Depleted uranium (DU) work**
  - April 1958 to about 1971
  - Machined and inspected DU products in Department 20 (about 12,000 ft^2 of the Main Manufacturing Building)
  - Main source of radiological exposure associated with machining items that contained DU oxide
  - Program using DU oxide ended in 1972

Background – continued

- Magnesium Thorium alloy (Mg-Th) work
  - Supplied by DOW - HK-31 alloy ~3% Thorium
  - May 1, 1957 to April 5, 1979 - machined and fabricated classified items with Mg-Th alloy in two areas of the Main Manufacturing Building (Department 20 and the Model Shop)
  - Strict operational controls to prevent airborne generation

Background – continued

- Thorium oxide (ThO_2) powder work
  - Reviewed one document that stated from July 23, 1958 to July, 1959 was handled in the plant.
  - Several personal communications with site experts and review of radiological source inventories found that handling was limited to small-scale laboratory analysis and preparation of solutions used in analytical procedures

Incidents

Erbium Tritide (September 30, 1987)

- Worker removed the cover of a W80 Data Analyzer and noticed that the interior not decontaminated as required, immediately replaced cover
- Surveys performed of the analyzer and the work area
- Contamination only detected on the inside of the cover at 986 dpm/100 cm^2

Incidents – continued

Erbium Tritide (cont.)

- Analyzer returned to Sandia National Laboratory for decontamination
- Urinalysis performed for the worker who removed the cover; results indicated no detectable activity for tritium as erbium tritide (sol class M from ICRP 71)
- This was an isolated, one time incident

Incidents – continued

Promethium-147 -February 10, 1989

- 100% beta-emitting, E_{Max} 224.7 keV, half-life of 2.6 years
- Failure of the integrity of one of these sources resulted in a spread of contamination to multiple areas inside and outside of facility
- 97 personnel internally monitored, no internal exposures
- Workers' homes inspected, one needed decontaminated

Sources of Available Information

- Site Profile TBD-6000, used to model internal doses for the natural uranium machining operations
- KCP Site Profile ORAUT-TKBS-0031 (2006), used to describe DU internal doses and external doses
- Reviewed 1,645 NIOSH Site Research Database documents
- Conducted 19 interviews
- Standard data searches conducted

Prior Dose Reconstructions

NIOSH DCAS Claims Tracking System

Information available as of November 22, 2013

- **KCP claims submitted for dose reconstruction** **672**
- **Cases submitted for energy employees who worked during the period under evaluation (1/1/49 - 12/31/93)** **665**
- **Number of dose reconstructions completed for energy employees who worked during the period under evaluation** **608**
- **Cases for which internal dosimetry records were obtained** **35**
- **Claims for which external dosimetry records were obtained** **103**

Personal Monitoring Data

- Internal Monitoring Data
  - Routine bioassay data (urinalysis) available for the DU work 1959 - 1971
  - Air sample data:
    - 1952 dust analysis
    - 1958 - 1971 Gross alpha Fixed-filter air monitoring in the Main Manufacturing Building general area

Personal Monitoring Data – continued

- **Internal Monitoring Data (cont.)**
  - **Air sample data:**
    - **Magnesium Thorium (Mg-Th) Operations**
    - **In 1970, KCP evaluated all of their Mg-Th machining operations in the Model Shop**
    - **The evaluation validated that KCP maintained airborne levels in the breathing-zone for long-lived activity at background, and short-lived activity at <3.22E-9 µCi/ml (gross alpha)**

Personal Monitoring Data – continued

- External Monitoring Data
- Access to 13,846 external dosimetry records that include monitoring data for deep dose, shallow dose, extremity dose (rings) and neutron dose, for the years 1950 - 1993
- KCP participated in DOE LAP performance testing using Landauer-provided services starting in October 1992

Area Monitoring Data

- Recently obtained copies of
  - 1959 - 1969 and 1990 - 1993 routine contamination and radiation surveys
  - Contamination survey data and volumetric sampling data from 1984-1986 Decontamination and Decommission (D&D) activities

Evaluated Period Potential Radiation Exposures

- Internal sources of exposure
  - Inhalation and ingestion of uranium and thorium by workers at KCP
  - Residual airborne radioactive contaminants may have been present at low levels after the operations ceased
- External sources of exposure
  - Photon / beta exposure from the uranium and thorium source material, and small amounts of surface contamination that was present after operations ceased.
  - Sources of neutron radiation involved Karman Model A-800 pulsed-neutron generators and ^{239}PuBe sources. The first presence of neutron-emitting sources occurred after 1965

Evaluated Period Potential Radiation Exposures

- External sources of exposure
  - Isotopic (beta, gamma-ray) sources that are typically used in manufacturing quality control procedures to monitor fabrication processes
  - Industrial radiation generating devices (X-rays and electron accelerators)

Feasibility of Dose Reconstructions

- Available monitoring records, process descriptions, and source-term data are adequate to complete DRs with sufficient accuracy for evaluated worker class

Feasibility Approach – continued

- **Natural Uranium Operations**
  - **NIOSH is satisfied that TBD-6000 can be used to estimate KCP exposures when dosimetry is not available**

Feasibility Approach – continued

- **Natural Uranium Post Operations Period**
  - Internal exposures after natural U operations ended and before DU internal monitoring started
  - March 1, 1955 to August 11, 1959
  - Use the maximum measured gross alpha air sample during this post operations period
  - Use TBD-6000 methodology to bound air concentrations for worker classes with less exposure potential than the machine operators

Feasibility Approach – continued

- Magnesium Thorium Operations
  - KCP specified engineered control levels at the beginning of operations in 1957 at 9E-11 µCi/ml
  - October of 1959 KCP lowered limit to 3E-11 µCi/ml
  - Performed (Gross α) fixed-filter air-monitoring in the Main Manufacturing Building (GA) during first 13 years of these operations
    - Maintained operations at 2.85E-12 µCi/ml (Average), <8.55E-11 µCi/ml (Maximum)

Feasibility Approach – continued

- **Magnesium Thorium Operations (cont.)**
  - The initial KCP limit of 9E-11 µCi/ml for Th_{232} would equate to ~27 mg/m^3 total-dust air-concentration; not well-tolerated for a full shift (W. R. Van Pelt, Bethlehem Steel study)
  - In 1970, KCP performed worksite, breathing-zone air-sampling (Gross α) and validated that their process does not generate airborne radioactivity
  - This validation was performed prior to KCP's cessation of fixed filter air-monitoring in 1971

Feasibility Approach – continued

- **Magnesium Thorium Operations (cont.)**
  - To bound internal exposures for machine operators, NIOSH will use:
    - initial engineered limit of 9E-11 µCi/ml and apply it in a constant manner from 5/1/57 through 10/31/59
    - lowered engineered limit of 3E-11 µCi/ml and apply it in a constant manner from 11/1/59 through 4/30/79
  - Ingestion doses derived with OCAS-TIB-009
  - Thoron exposure: use highest 1970 short-lived sample, 3.2E-9 µCi/ml yields, 5.1 WLM/yr
  - TBD-6000 methodology used to bound air concentrations for classes of workers with less exposure potential or that spent less time in the machining area than the machine operators

Feasibility Approach – continued

- **Bounding thorium intakes after Mg-Th operations ceased and before facility D&D**
  - Assume air concentration at the end of operations was the lower limit of 3E-11 µCi/ml (66.6 dpm/m^3)
  - Use deposition, re-suspension and depletion models to assign intakes.
  - Ingestion doses derived using OCAS-TIB-009

Feasibility Approach – continued

- Bounding thorium intakes after Mg-Th operations ceased and before facility D&D
- Thoron dose basis for this period will start the period at 5.1 WLM/yr and will use the same depletion rate (4.23 E-4/yr) to determine the exposure for each year of this period
- TBD-6000 methodology used to bound air concentrations for classes of workers with less exposure potential or that spent less time in the machining area than the machine operators

Feasibility Approach – continued

- **Bounding uranium intakes after Mg-Th operations ceased and before facility D&D**
  - Maximum measured surface contamination survey taken during DU machining operations will be used to model a starting point air concentration for this post-operational period

Feasibility Approach – continued

- **Bounding uranium intakes after Mg-Th operations ceased and before facility D&D**
  - **Applying a re-suspension factor of 1E-5/m, yields an air concentration of 0.6 dpm/m^3 (0.27 pCi/ m^3) for the end of the post operations period on May 31, 1984**
  - **A depletion rate will be applied to the initial air concentration to determine the remaining activity available for inhalation and ingestion for machine operators during each year of this post operations period**

Feasibility Approach – continued

- **Bounding uranium intakes after Mg-Th operations cease and before facility D&D**
  - TBD-6000 methodology used to bound air concentrations for classes of workers with less exposure potential or that spent less time in the machining area than the machine operators

Feasibility Approach – continued

- D&D Activities 6/1/84 – 9/3/86
  - Rockwell employees were monitored
  - Barriers set-up around work area and continuous air monitoring performed outside perimeter
  - Monitored for U_{238} at 1E-12 µCi/ml control level
  - Assume KCP employees are exposed at the perimeter air-concentration during this period

Summary

Summary of Feasibility (January 1, 1949 through December 31, 1993)		
Source of Exposure	**Feasible**	**Not Feasible**
External	X	
Internal	X	