REPORT TO THE ADVISORY BOARD ON RADIATION AND WORKER HEALTH

National Institute of Occupational Safety and Health

Audit of Case PIID* from the Rocky Flats Plant

Contract No. 200-2004-03805
Task Order No. 4

SCA-TR-TASK4-CNPIID*

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U. Hans Behling, PhD, MPH</td><td rowspan="2">Supersedes:

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1.0 SUMMARY BACKGROUND INFORMATION

This report presents the results of an independent audit of a dose reconstruction performed by the National Institute of Occupational Safety and Health (NIOSH) for an energy employee that worked at the Rocky Flats Plant for PIID* years, from PIID*, through PIID*. This period included the time when the Rocky Flats Plant produced plutonium triggers for nuclear weapons and processed weapons for plutonium recovery.

Because the claimant was employed as a PIID* in a radiation controlled area, the worker may have experienced internal exposure due to the intake of particles of plutonium oxide in the workplace and outside environment, and external exposure from working near the production operations.

The employee was diagnosed with lung cancer on PIID*. For reason of dose reconstruction efficiency, NIOSH determined that only a partial dose reconstruction was sufficient to produce a probability of causation of 50% or greater. NIOSH based the reconstruction on missed doses from the energy employee's urinalysis data and derived a probability of causation (POC) of 79.19%.

Table 1 presents an overall summary of NIOSH's dose reconstruction.

Table 1. Summary of Internal/External Exposures as Estimated by NIOSH

	Appendix A Exposure Entry No.	Dose (rem)
External Dose:		
▪ Photon Dosimeter Dose	NC*	—
▪ Photon Missed Dose	NC*	—
▪ Neutron Dosimeter Dose	NC*	—
▪ Neutron Missed Dose	NC*	—
▪ Occupational Medical	NC*	—
▪ Onsite Ambient	NC*	—
Internal Dose:	1 – 22	Mode = 52 Max. = 104

*NC = Not considered because exposure scenario was not needed to show causation

1.1 AUDIT OBJECTIVES

SC&A's audit was performed with the following objectives:

- To determine if NIOSH assigned doses that are consistent with monitoring records provided by DOE and with the information contained in the CATI report
- To determine if the dose reconstruction process complied with applicable procedures that include generic procedures developed by NIOSH and ORAUT, as well as data/procedures that are site-specific

- In instances when procedure(s) provide more than one option or require subjective decisions, determine if the process is scientifically defensible and/or claimant favorable

In pursuit of these objectives, a two-step process is followed in this audit. The first step of this audit is to independently duplicate, and therefore validate, doses derived by NIOSH. This step of the audit process is not only contractually mandated under Task 4, but provides NIOSH and the Advisory Board with a high level of assurance that the SC&A reviewer understands which procedures, models, site-specific data, and assumptions NIOSH used to perform its dose reconstruction. The second step of the audit critically evaluates whether the methods employed by NIOSH are technically defensible, consistent with applicable procedures, and claimant favorable.

Lastly, in compliance with the Privacy Act, this report makes no reference to the claimant's name, SSN, address, or any personal data that might reveal the identity of the claimant.

1.2 SUMMARY OF AUDIT FINDINGS

An overview of SC&A's audit findings for Case PIID* is provided in Table 2 in the form of a checklist. This checklist evaluates the data collection process, information obtained from the CATI interview, and all methods used in the dose reconstruction. When deficiencies are identified by the audit, such deficiencies are further characterized with regard to their impact(s) by means of the following definitions: (1) **low** means that the deficiency has only a marginal impact on dose; (2) **medium** means that the deficiency substantially impacts the dose, but is unlikely to impact the compensability of the case; and (3) **high** means that the deficiency substantially impacts the dose and may also impact the compensability of the case. A full description of deficiencies identified in the checklist is provided in the text of the audit that follows.

Table 2. Case Review Checklist

CASE PIID*	ASSIGNED DOSE: 52 rem	POC: 79.19%

No.	Description of Technical Elements of Review	Audit Response			If No, Potential Significance		
		YES	N/A	NO	LOW[1]	MEDIUM[2]	HIGH[3]
A. REVIEW OF DATA COLLECTION:							
A.1	Did NIOSH receive all requested data for the DOE or AWE site from any relevant data source?	✓					
A.2	Is the data used by NIOSH for the case adequate to make a determination with regard to POC?	✓					
B. REVIEW OF INTERVIEW AND DOCUMENTATION PROVIDED BY CLAIMANT							
B.1	Did NIOSH properly address all work history dates/locations of employment reported by claimant?	✓					
B.2	Did NIOSH properly address all incidents/occurrences reported by claimant?	✓					
B.3	Did NIOSH properly address monitoring/ personal protection/work practices reported by claimant?	✓					
B.4	Is the interview information consistent with data used for dose estimate?	✓					
C. REVIEW OF PHOTON DOSES							
C.1	Was the appropriate procedure used for determining:						
C.1.1	- Recorded Photon Dose?		✓				
C.1.2	- Missed Photon Dose?		✓				
C.1.3	- Occupational Medical Dose?		✓				
C.1.4	- Onsite-Ambient Dose?		✓				
C.2	Did the DR properly account for all:						
C.2.1	- Recorded Photon Dose?		✓				
C.2.2	- Missed Photon Dose?		✓				
C.2.3	- Occupational Medical Dose?		✓				
C.2.4	- Onsite-Ambient Dose?		✓				
C.3	Is the recorded/assigned dose properly converted to the organ dose of interest for:						
C.3.1	- Recorded Photon Dose?		✓				
C.3.2	- Missed Photon Dose?		✓				
C.3.3	- Occupational Medical Dose?		✓				
C.3.4	- Onsite-Ambient Dose?		✓				
C.4	Is the organ dose uncertainty properly determined for:						
C.4.1	- Recorded Photon Dose?		✓				
C.4.2	- Missed Photon Dose?		✓				
C.4.3	- Occupational Medical Dose?		✓				
C.4.4	- Onsite-Ambient Dose?		✓				
D. REVIEW OF SHALLOW (i.e., 7 mg/cm^2)/ELECTRON DOSES							
D.1	Was the appropriate procedure used for determining:						
D.1.1	- Recorded Shallow/Electron Dose?		✓				
D.1.2	- Missed Shallow/Electron Dose?		✓				
D.1.3	- Onsite Ambient Dose?		✓				
D.2	Did the DR properly account for all:						
D.2.1	- Recorded Shallow/Electron Dose?		✓				
D.2.2	- Missed Shallow/Electron Dose?		✓				
D.2.3	- Onsite Ambient Dose?		✓				
D.3	Is the recorded/assigned dose properly converted to the organ dose of interest for:						
D.3.1	- Recorded Shallow/Electron Dose?		✓				

[1] **Low** means that the deficiency has only a marginal impact on dose.
[2] **Medium** means that the deficiency substantially impacts the dose, but is unlikely to impact the compensability of the case.
[3] **High** means that the deficiency substantially impacts the dose and may also impact the compensability of the case.

CASE PIID*	ASSIGNED DOSE: 52 rem	POC: 79.19%

No.	Description of Technical Elements of Review	Audit Response			If No, Potential Significance		
		YES	N/A	NO	LOW[1]	MEDIUM[2]	HIGH[3]
D.3.2	- Missed Shallow/Electron Dose?		✓				
D.3.3	- Onsite Ambient Dose?		✓				
D.4	Is the organ dose uncertainty properly determined for:						
D.4.1	- Recorded Shallow/Electron Dose?		✓				
D.4.2	- Missed Shallow/Electron Dose?		✓				
D.4.3	- Onsite Ambient Dose?		✓				
E. REVIEW OF NEUTRON DOSES							
E.1	Was the appropriate procedure used for determining:						
E.1.1	- Recorded Neutron Dose?		✓				
E.1.2	- Assigned Neutron Dose?		✓				
E.1.3	- Missed Neutron Dose?		✓				
E.2	Did the DR properly account for all:						
E.2.1	- Recorded Neutron Dose?		✓				
E.2.2	- Assigned Neutron Dose?		✓				
E.2.3	- Missed Neutron Dose?		✓				
E.3	Is the recorded/assigned dose properly converted to the organ dose of interest for:						
E.3.1	- Recorded Neutron Dose?		✓				
E.3.2	- Assigned Neutron Dose?		✓				
E.3.3	- Missed Neutron Dose?		✓				
E.4	Is the organ dose uncertainty properly determined for:						
E.4.1	- Recorded Neutron Dose?		✓				
E.4.2	- Assigned Neutron Dose?		✓				
E.4.3	- Missed Neutron Dose?		✓				
F. REVIEW OF INTERNAL DOSE: BASED ON HYPOTHETICAL MODEL							
F.1	Is the use of the selected hypothetical internal dose model appropriate, based on the likely POC value?		✓				
F.2	Is the use of a hypothetical internal dose model appropriate/conservative, based on claimant's available bioassay data,?		✓				
F.3	Was the hypothetical dose value correctly derived?		✓				
G. REVIEW OF INTERNAL DOSE: BASED ON BIOASSAY/IMBA							
G.1	Was the appropriate procedure (or section of procedure) used for determining likely (>50%), unlikely (<50%), or undetermined POC and compensability?	✓					
G.2	Are bioassay data sufficiently adequate for internal dose reconstruction?	✓					
G.3	Are assumptions pertaining to dates of uptake reasonable/conservative?	✓					
G.4	Are critical parameters (e.g., solubility class, particle size, etc.) used for IMBA organ dose estimates appropriate?	✓					
G.5	Are assigned uncertainties (measurement errors) for bioassay data (used as input to IMBA) appropriate?	✓					
H. Total Number of Deficiencies and Their Combined Potential Significance				0			

[1] **Low** means that the deficiency has only a marginal impact on dose.
[2] **Medium** means that the deficiency substantially impacts the dose, but is unlikely to impact the compensibility of the case.
[3] **High** means that the deficiency substantially impacts the dose and may also impact the compensibility of the case.

2.0 AUDIT OF ASSIGNED DOSES

2.1 INTERNAL EXPOSURE TO THE LUNG FROM MISSED DOSE BASED ON BIOASSAY DATA

For Case # PIID*, NIOSH only needed to conduct a partial dose assessment using missed urinalysis data to derive a dose sufficient to result in a probability of causation (POC) greater than 50%. This partial dose assessment was based on seven urine bioassay samples provided by the claimant between PIID* and PIID*. All bioassay analyses yielded Pu-239 results that were below MDA.

Using a two-step IMBA process, NIOSH modeled the urine bioassay data to reconstruct the lung dose from Pu-239. By assuming a urine concentration at the MDA level, the IMBA code first back-calculated the inhalation intake for Pu that corresponded to the MDA level. For the second step, IMBA calculated the lung dose that corresponded to the inhalation quantity derived in the first step.

For the time period of concern, NIOSH assumed a urine MDA value of 0.24 dpm/d ± 0.072, as defined in ORAUT-TKBS-0011-5. NIOSH further assumed a **chronic** intake and the insoluble form Type S for plutonium. Based on this model and parameter values, NIOSH assumed one half maximum value as the mode of a triangular distribution with a minimum value of 0. They used the triangular distribution as input into the causation calculation.

2.1.1 Reviewer's Comments

SC&A reviewed the DOE records and verified that the individual was provided a bioassay for the following dates:

- PIID*
- PIID*
- PIID*
- PIID*
- PIID*
- PIID*
- PIID*

These records indicated no detectable plutonium in the urine.

A review of the TBD also confirmed that NIOSH used the correct MDA value for the period PIID*– PIID* for plutonium, which are cited in Table 5.3.1.2-1 of ORAUT-TKBS-0011-5. To account for uncertainty, the TBD states that a standard deviation is the value provided in Table 5.3.1.2-1 divided by 3.3, which NIOSH correctly calculated.

SC&A also verified the resulting maximum doses cited in Appendix A of this report by independently running the IMBA code. Based on this independent verification, it was determined that the use of a triangular distribution for the missed lung dose with the mode at half the maximum value is claimant favorable.

Using the S Type solubility for plutonium is also claimant favorable. This results in a slower lung clearance and a longer residence time for plutonium, which maximizes the dose to the lung.

Because the calculated missed dose to the lung was sufficient to show causation, we agree that there was no need to reconstruct doses from other exposure pathways. This abridged dose reconstruction is an efficiency measure that is endorsed by procedural guidance and Federal regulations.

REFERENCES

ACJ & Associates and the UK National Radiological Protection Board, "Integrated Modules for Bioassay Analysis, (IMBA), Phase 1," Software produced for NIOSH-OCAS as part of the EEOICPA program, Version 1.0.63, UK, November 2002.

"NIOSH Report of Dose Reconstruction Under the Energy Employee Occupational Illness Compensation Program Act (EEOICPA)." NIOSH ID: 011014.

OCAS-IG-002. 2002. "Internal Dose Reconstruction Implementation Guideline," Rev. 0. National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio, August 2002.

ORAUT-TKBS-0011-5. 2004. "Technical Basis Document for the Rocky Flats Plant to be Used for EEOICPA Dose Reconstruction," January 12, 2004.

APPENDIX A: IREP INPUT

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