REPORT TO THE ADVISORY BOARD ON RADIATION AND WORKER HEALTH

National Institute of Occupational Safety and Health

Audit of Case #PIID* from Fernald

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SCA-TR-TASK4-CNPIID*

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<tr><td>AUDIT OF CASE #PIID* FROM FERNALD</td><td>Page 2 of 10</td></tr>
<tr><td>Task Manager: _____ Date: 02/04/05
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Draft Rev. 0</td></tr>
<tr><td>Project Manager: _____ Date: 02/04/05
John Mauro, PhD, CHP</td></tr>
</table>

TABLE OF CONTENTS

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 Feed Materials Production Company (FMPC or Fernald) as a PIID*, PIID*, and PIID* for approximately **PIID*** over two time periods; **PIID***. Most of this employment period was spent in **PIID***.

As a result of the claimant's employment, the worker experienced occupational exposures to external radiation sources, as well as exposure to internally deposited radioactive material. The worker was provided with film badge or TLD dosimeters to measure external exposures to gamma and beta radiation. Internal exposures were **not** evaluated by NIOSH for this case, so factors involved in the employee's internal dose estimates were not evaluated.

The employee was diagnosed with **PIID***. He was also diagnosed with basal cell carcinoma on two occasions; **PIID*** (right temple), and **PIID*** (cheek). Because skin cancer was involved, NIOSH first determined the probability of causation (POC) for the skin cancer due to external exposure alone. Annual external beta dose was determined from DOE dosimetry records, and the results were input into IREP. Based on a partial dose reconstruction, this case was determined to have a POC of 54.23% for the basal cell carcinomas.

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

Table 1. Summary of External Exposures as Estimated by NIOSH

	Appendix A Exposure Entry No.	Dose (rem)
External Dose:		
▪ Electron (>15 keV) Dosimeter Dose	1 – 22	23.697
▪ Photon Dosimeter Dose	NC*	—
▪ Photon Missed Dose	NC*	—
▪ Neutron Dosimeter Dose	NC*	—
▪ Neutron Missed Dose	NC*	—
▪ Occupational Medical	NC*	—
▪ Onsite Ambient	NC*	—
Internal Dose:	NC*	—
Total		23.697

*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 the 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* PIID*	ASSIGNED DOSE: 23.697 rem	POC: 54.23%

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* PIID*	ASSIGNED DOSE: 23.697 rem	POC: 54.23%

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				4	✓		

[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.

2.0 AUDIT OF EXTERNAL DOSES

2.1 SKIN DOSES

Appendix A presents the results of NIOSH's partial reconstruction of the external annual skin doses to the energy employee for the purpose of deriving the probability of causation (POC) using IREP. These annual skin doses due to beta radiation were determined by subtracting the DOE-reported deep dose equivalent for each year from the DOE-reported shallow dose equivalent for that year. The net skin dose was entered as a "constant" value.

The skin dose is an **underestimate** of the total dose received, since the photon deep dose and dose from internally deposited radionuclides were not considered. The POC for the two basal cell carcinomas taken together was determined by NIOSH to be 54.23%.

2.2 REVIEWER'S COMMENTS

As part of this audit, SC&A was able to duplicate the skin doses as "defined" by the protocol used by NIOSH. SC&A also recognizes that NIOSH may have opted to employ a "simplified" dose reconstruction approach that is considered "efficient," as provided by 42 CFR 82. In instances where the POC is likely to exceed 50%, efficiency measures allow for a partial or limited dose reconstruction. Thus, SC&A fully accepts a dose reconstruction that is confined to the measured external shallow dose for a claim involving skin cancer.

What SC&A does not consider scientifically appropriate and clearly not "efficient" was NIOSH's decision to unnecessarily subtract the deep dose from the shallow dose for deriving the skin dose. When properly calibrated, the shallow dose defines the dose at 7 mg/cm^2, which is the appropriate dose that is assigned to the skin. (See Section 6.3.1 of ORAUT-PROC-0006, and Attachment A, page 41, of ORAUT-PROC-0006; and the most recently issued procedure ORAUT-OTIB-0017, *Interpretation of Dosimetry Data for Assignment of Shallow Dose*.) The shallow dose may be the result of photons, betas, or neutrons, or any combination of these radiations. Under normal circumstances, the recorded annual shallow doses would be assumed to have an uncertainty, which was not included. In behalf of dose reconstruction efficiency, however, the failure to include uncertainty for recorded doses is justified.

Due to the fact that the partial dose reconstruction that was limited to external film dosimeter measurements sufficed in producing a POC >50%, neither internal dose estimates nor other external dose estimates were required for this case.

REFERENCES

NIOSH 2002a. "External Dose Reconstruction Implementation Guideline," OCAS-IG-001, Revision 1. August 2002.

APPENDIX A: IREP INPUT

Deletions made to the following table -- please see hard copy labeled "#17- Fernald"