
DRAFT

**REPORT TO THE ADVISORY BOARD
ON RADIATION AND WORKER HEALTH**

National Institute for Occupational Safety and Health

**COMPARISON OF SC&A'S BLIND DOSE RECONSTRUCTION
TO NIOSH'S DOSE RECONSTRUCTION OF CASE # [REDACT]
FROM THE NATIONAL SECURITY COMPLEX (Y-12)**

**Contract No. 211-2014-58081
SCA-TR-DRC2015-CN [Redact]**

Prepared by

Ron Buchanan, PhD, CHP
S. Cohen & Associates
1608 Spring Hill Road, Suite 400
Vienna, Virginia 22182

March 2015

NOTICE: This report has been reviewed for Privacy Act information and has been cleared for distribution. However, this report is pre-decisional and has not been reviewed by the Advisory Board on Radiation and Worker Health for factual accuracy or applicability within the requirements of 42 CFR 82.

Effective Date: March 25, 2015	Revision No. 0 (Draft)	Document No. SCA-TR-DRC2015-CN[Redact]	Page No. 2 of 12
------------------------------------------	----------------------------------	--------------------------------------------------	----------------------------

S. Cohen & Associates: <i>Technical Support for the Advisory Board on Radiation & Worker Health Review of NIOSH Dose Reconstruction Program</i>	Document No. SCA-TR-DRC2015-CN[Redact]
	Effective Date: Draft – March 25, 2015
Comparison of SC&A’s Blind Dose Reconstruction to NIOSH’s Dose Reconstruction of Case # [Redact] from the National Security Complex (Y-12)	Page 2 of 12
Task Manager: _____ Date: _____ Douglas Farver, CHP	Supersedes: N/A
Project Manager: _____ Date: _____ John Stiver, MS, CHP	Reviewer: Kathleen Behling Douglas Farver Rose Gogliotti

Record of Revisions

Revision Number	Effective Date	Description of Revision
0 (Draft)	03/25/2015	Initial issued.

NOTICE: This report has been reviewed for Privacy Act information and has been cleared for distribution. However, this report is pre-decisional and has not been reviewed by the Advisory Board on Radiation and Worker Health for factual accuracy or applicability within the requirements of 42 CFR 82.

TABLE OF CONTENTS

Abbreviations and Acronyms	4
1.0 Relevant Background Information.....	5
2.0 Comparison of Methodology/Doses used by NIOSH and SC&A for Case #[Redact].....	7
2.1 Occupational External Dose Calculations	8
2.1.1 Recorded/Missed/Unmonitored External Doses.....	8
2.1.2 Occupational Medical Doses	8
2.2 Occupational Internal Doses	9
2.2.1 Recorded/Missed/Unmonitored Internal Doses.....	9
3.0 Summary Conclusions	10
References.....	11
Addendum A: SC&A’s Blind Dose Reconstruction Report of Case #[Redact].....	12

LIST OF TABLES

Table 1-1. Comparison of NIOSH’s Assigned Doses to SC&A’s Blind DR Doses	6
Table 2-1. Comparison of Data and Assumptions Used by NIOSH and SC&A.....	7
Table 2-2. Secondary Cancers and Their Related Primary Cancer Sites for Medical X-rays	9
Table 2-3. Comparison of Occupational Medical Doses	9
Table 3-1. Comparison of Total External and Internal Doses Estimated	10

NOTICE: This report has been reviewed for Privacy Act information and has been cleared for distribution. However, this report is pre-decisional and has not been reviewed by the Advisory Board on Radiation and Worker Health for factual accuracy or applicability within the requirements of 42 CFR 82.

Effective Date: March 25, 2015	Revision No. 0 (Draft)	Document No. SCA-TR-DRC2015-CN[Redact]	Page No. 4 of 12
------------------------------------------	----------------------------------	--------------------------------------------------	----------------------------

ABBREVIATIONS AND ACRONYMS

Advisory Board	Advisory Board on Radiation and Worker Health
CATI	Computer-Assisted Telephone Interview
DCF	dose conversion factor
DOE	(U.S.) Department of Energy
DOL	(U.S.) Department of Labor
DR	dose reconstruction
EE	Energy Employee
EEOICPA	Energy Employees Occupational Illness Compensation Program Act of 2000
ICD	International Classification of Diseases
IREP	Interactive RadioEpidemiological Program
keV	kiloelectron volts
NIOSH	National Institute for Occupational Safety and Health
ORAUT	Oak Ridge Associated Universities Team
PFG	photofluorography
POC	probability of causation
rem	Roentgen equivalent man
SC&A	S. Cohen and Associates (SC&A, Inc.)
SD	standard deviation
SEC	Special Exposure Cohort
TBD	technical basis document
TIB	technical information bulletin

NOTICE: This report has been reviewed for Privacy Act information and has been cleared for distribution. However, this report is pre-decisional and has not been reviewed by the Advisory Board on Radiation and Worker Health for factual accuracy or applicability within the requirements of 42 CFR 82.

Effective Date: March 25, 2015	Revision No. 0 (Draft)	Document No. SCA-TR-DRC2015-CN[Redact]	Page No. 5 of 12
------------------------------------------	----------------------------------	--------------------------------------------------	----------------------------

1.0 RELEVANT BACKGROUND INFORMATION

Under Contract No. 211-2014-58081, SC&A was tasked by the Advisory Board on Radiation and Worker Health (Advisory Board) to perform six blind dose reconstructions (DRs) at the July 2014, DR Subcommittee meeting. SC&A was provided all of the Department of Energy (DOE) dosimetry records; the Department of Labor (DOL) correspondence, forms, and medical records; and the Computer-Assisted Telephone Interview (CATI) Reports that were made available to the National Institute for Occupational Safety and Health (NIOSH) for constructing doses in behalf of these cases. SC&A used an independent approach to reconstruct occupational external and internal doses for the cases using the available dosimetry records and current guidance from NIOSH, including the spreadsheets and other tools developed by NIOSH to calculate the doses.

On February 12, 2015, SC&A submitted to the Advisory Board and NIOSH, a memorandum containing the summary results of our blind DR in behalf of Case #[Redact]. The complete DR report entitled, *Blind Dose Reconstruction of Case #[Redact] from the Y-12 National Security Complex* (SCA-TR-BDR2015-CN[Redact]), which provides the assumptions and methodologies used to derived occupational radiation doses and resultant probability of causation (POC), is included herein as Addendum A. In this report, SC&A presents a comparison between NIOSH's and SC&A's DR methodologies, doses, and resultant POC values for Case #[Redact]. Table 1-1 summarizes the external and internal occupational doses calculated by SC&A and the NIOSH-assigned doses for the lung, bone, and metastatic carcinoma cancers diagnosed in behalf of Case #[Redact]. A detailed comparison of the two methodologies used to calculate doses in behalf of this case is presented in Section 2. Section 3 of this report provides Summary Conclusions.

It should be noted that where appropriate, an explanation is provided regarding the differences in doses and why they occurred; however, SC&A does not make any value judgments regarding which among them may be the more preferred approach. It is our position that further discussions are best addressed by the DR Subcommittee.

Table 1-1. Comparison of NIOSH's Assigned Doses to SC&A's Blind DR Doses

	NIOSH Lung Doses (rem)	NIOSH Carcinoma Doses (rem)	NIOSH Bone Doses (rem)	SC&A Lung Doses (rem)	SC&A Bone Doses (rem)	SC&A Carcinoma Doses (rem)
External Dose (Occupational):						
▪ Recorded Dose						
- Photons <30 keV	NA	NA	NA	NA	NA	NA
- Photons 30–250 keV	NA	NA	NA	NA	NA	NA
- Neutrons	NA	NA	NA	NA	NA	NA
▪ Missed Dose						
- Photons <30 keV	NA	NA	NA	NA	NA	NA
- Photons 30–250 keV	NA	NA	NA	NA	NA	NA
- Neutrons	NA	NA	NA	NA	NA	NA
▪ Unmonitored Dose						
- Photons <30 keV	NA	NA	NA	NA	NA	NA
- Photons 30–250 keV	NA	NA	NA	NA	NA	NA
- Neutrons	NA	NA	NA	NA	NA	NA
▪ Occupational Medical Dose						
- Photons 30–250 keV	12.150	4.050	3.780	12.150	3.780	4.050
Internal Dose:	NA	NA	NA	NA	NA	NA
Total Cancer Dose	12.150	4.050	3.780	12.150	3.780	4.050
Cancer POC	27.67	11.22	22.29	27.71	21.29	11.22
Combined POC			49.46%			49.48%

NA = not applicable or not analyzed.

NOTICE: This report has been reviewed for Privacy Act information and has been cleared for distribution. However, this report is pre-decisional and has not been reviewed by the Advisory Board on Radiation and Worker Health for factual accuracy or applicability within the requirements of 42 CFR 82.

2.0 COMPARISON OF METHODOLOGY/DOSES USED BY NIOSH AND SC&A FOR CASE # [Redact]

Case # [Redact] represents an energy employee (EE) who worked at the National Security Complex (Y-12) from [Redact], through [Redact]. According to the DOE records, the majority of the EE's radiation exposure was received while working as a [Redact] at Y-12.

The EE was not monitored for external or internal exposures. In [Redact], the EE was diagnosed with **secondary lung cancer** (ICD-9 Code 197.0), **secondary bone cancer** (ICD-9 Code 198.5), and **unknown primary metastatic carcinoma** (ICD-9 Code 199).

For calculating radiation doses from employment at Y-12, both DR methods primarily relied on guidance in the Technical Basis Document (TBD) for Y-12 (issued as six separate documents numbered ORAUT-TKBS-0014-1 through ORAUT-TKBS-0014-06) and ORAUT-OTIB-0005, *Technical Information Bulletin: Internal Dosimetry Organ, External Dosimetry Organ, and IREP Model Selection by ICD-9 Code*. Using the guidance provided in the relevant documents, along with the EE's records, NIOSH and SC&A employed a **best-estimate approach** for calculating annual organ doses.

A summary of the documents, assumptions, and dose parameters used by each DR method is provided in Table 2-1:

Table 2-1. Comparison of Data and Assumptions Used by NIOSH and SC&A

Parameters	NIOSH	SC&A
<i>External Dose</i>		
<i>Recorded/Missed/Unmonitored:</i>		
Records/Guidance Documents	DOE records, Y-12 TBD-6.	DOE records, Y-12 TBD-6.
Work Locations	Freight facilities at Y-12.	Freight facilities at Y-12.
Energy Range/DCF	NA	NA
Dosimeter Uncertainty Factor	NA	NA
Dose Distribution	NA	NA
<i>External Medical X-rays:</i>		
Guidance Documents	Y-12 TBD-3, OTIB-0005, OTIB-0006, OTIB-0079.	Y-12 TBD-3 and OTIB-0005.
Frequency	Annual x-ray exam and termination x-ray exam.	Annual and termination x-ray exams, based on Table 3-1 of Y-12 TBD-3.
Dose Data	Y-12 TBD-3	Y-12 TBD-3 (Table A-2)
Dose Distribution	Normal; SD = 30%.	Normal; SD = 30%.
<i>Internal Dose</i>		
<i>Recorded/Missed/unmonitored:</i>		
Records/Guidance Documents	DOE records, Y-12 TBD-5.	DOE records, Y-12 TBD-5.
Dose Determination Approach	NA	NA
Solubility Type	NA	NA
<i>POC Program:</i>		
NIOSH-IREP POC	Ver. 5.7	Ver. 5.7.1

NOTICE: This report has been reviewed for Privacy Act information and has been cleared for distribution. However, this report is pre-decisional and has not been reviewed by the Advisory Board on Radiation and Worker Health for factual accuracy or applicability within the requirements of 42 CFR 82.

Effective Date: March 25, 2015	Revision No. 0 (Draft)	Document No. SCA-TR-DRC2015-CN[Redact]	Page No. 8 of 12
------------------------------------------	----------------------------------	--------------------------------------------------	----------------------------

2.1 OCCUPATIONAL EXTERNAL DOSE CALCULATIONS

2.1.1 Recorded/Missed/Unmonitored External Doses

The DOE records show that the EE was not monitored for external exposures. According to ORAUT-TKBS-0014-6, page 12, external doses, except occupational medical dose, cannot be reconstructed during the EE's employment time period of [redact]–[redact], as per the Y-12 Special Exposure Cohort (SEC). Therefore, neither NIOSH nor SC&A could assign recorded/missed/ unmonitored dose in this case. The EE failed to qualify as a member of the SEC class since the EE did not work for a total of 250 days during the SEC period.

2.1.2 Occupational Medical Doses

Both DR methods calculated an occupational medical dose from diagnostic x-ray procedures required as a condition of employment. NIOSH indicated that they followed guidance cited in the following four guidance documents in order to calculate their occupational medical doses:

1. ORAUT-TKBS-0014-3, *Technical Basis Document for the National Security Complex – Occupational Medical Dose, Rev. 01.*
2. ORAUT-OTIB-0005. *Technical Information Bulletin: Internal Dosimetry Organ, External Dosimetry Organ, and IREP Model Selection by ICD-9 Code, Rev 05.*
3. ORAUT-OTIB-0006, *Technical Information Bulletin: Dose Reconstruction from Occupational Medical X-Ray Dose Procedures, Rev. 04.*
4. ORAUT-OTIB-0079, *Technical Information Bulletin: Guidance on Assigning Occupational X-Ray Dose under EEOICPA for X-Rays Administered Off Site, Rev 00.*

SC&A used guidance provided in the Y-12 TBD (ORAUT-TKBS-0014-3) and ORAUT-OTIB-0005.

Both NIOSH and SC&A assigned dose for a pre-employment x-ray exam in [redact] (the EE's starting date was [redact]); therefore, another x-ray exam would most likely not be conducted in [redact]), an annual exam in [redact], and a termination exam in [redact], for a total of three exams. SC&A used the recommended exam frequency in Table 3-1, page 9, and the recommended organ doses in Table A-2, page 22, of ORAUT-TKBS-0014-3.

This EE had secondary cancers with unknown primaries. According to ORAUT-OTIB-0005, Table 3-2, page 41, in this case, the dose reconstructor is to evaluate the potential primary cancers and use the primary cancer site that provides for the greater dose for each of the secondary cancers. Table 2-2 of this report provides a summary of the three secondary cancer sites and their respective primary sites.

Table 2-2. Secondary Cancers and Their Related Primary Cancer Sites for Medical X-rays

Secondary Cancer ICD-9 Code	Secondary Cancer	Potential Primary Cancer ICD-9 Code	Potential Primary Cancer Site*
197.0	Lung	153	Colon
		162	Lung
		172	Skin
		185	Bladder
		188	Bladder
198.5	Bone	189	Liver
		162	Lung
		185	Bladder
199	Metastatic Carcinoma	199	Remainder

*Organ that produced the greater dose is shown in bold font.

The medical x-ray doses for a photofluorography (PFG) exam for each of these potential primary organs were obtained from Table A-2, page 22, of ORAUT-TKBS-0014-3. The greater of the primary dose was assigned for the secondary cancer site, i.e., for the lung, the skin dose (4.050 rem) represented the most claimant-favorable dose; for the bone, the lung dose (1.260 rem) was highest; and for the carcinoma, the remainder dose (1.350 rem) was the most claimant favorable. These organs are in bold text in Table 2-2.

From the Interactive RadioEpidemiological Program (IREP) Input tables in NIOSH's DR Report, it appears that NIOSH used the same methods and assigned the same doses that SC&A derived. Table 2-3 summarizes NIOSH's and SC&A's dose assignments.

Table 2-3. Comparison of Occupational Medical Doses

Cancer	NIOSH (rem)	SC&A (rem)
Lung	12.150	12.150
Bone	3.780	3.780
Metastatic carcinoma	4.050	4.050

Each DR method entered the annual doses into the IREP Input tables with a normal distribution and a standard deviation (SD) of 30%.

2.2 OCCUPATIONAL INTERNAL DOSES

2.2.1 Recorded/Missed/Unmonitored Internal Doses

The DOE records show that the EE was not monitored for internal intakes. According to ORAUT-TKBS-0014-5, page 11, internal doses cannot be reconstructed during the EE's employment time period of [redact]–[redact]. Therefore, neither NIOSH nor SC&A could assign recorded/missed/unmonitored internal doses in this case.

3.0 SUMMARY CONCLUSIONS

Total external and internal doses and resultant POCs calculated by NIOSH and SC&A in behalf of Case # [Redact] are presented in Table 3-1 for comparison.

Table 3-1. Comparison of Total External and Internal Doses Estimated

Total Dose	NIOSH Lung (rem)	SC&A Lung (rem)	NIOSH Bone (rem)	SC&A Bone (rem)	NIOSH Carcinoma (rem)	SC&A Carcinoma (rem)
External Dose:	NA	NA	NA	NA	NA	NA
Occupational Medical Dose	12.105	12.105	3.780	3.780	4.050	4.050
Internal Dose:	NA	NA	NA	NA	NA	NA
Total Dose	12.105	12.105	3.780	3.780	4.050	4.050
POC	27.67%	27.71%	21.29%	21.29%	11.22%	11.22%

As shown in Table 3-1, NIOSH's and SC&A's methods resulted in individual cancer POCs, and a combined total POC, that were nearly identical; NIOSH derived a total combined POC of **49.46%** compared to **49.48%** for SC&A. The slight difference between NIOSH's and SC&A's POC value for the lung cancer may be due to the version of the NIOSH IREP POC program used; i.e., NIOSH used Ver. 5.7 and SC&A used Ver. 5.7.1.

The following summarizes/compares the methods used by NIOSH and SC&A to assign doses in this case:

- Dose Reconstruction Methodology
 - Both NIOSH and SC&A employed a best-estimate approach to dose reconstruction.
- Assignment of Unmonitored External Dose
 - Neither NIOSH nor SC&A could assign unmonitored external dose because of the Y-12 SEC during the EE's employment period, and the EE did not qualify as a member of the class due to not having worked at least 250 days.
- Assignment of Occupational Medical Dose
 - NIOSH and SC&A used the same methodology in assigning medical doses.
- Assignment of Internal Doses
 - Neither NIOSH nor SC&A could assign unmonitored internal dose because of the Y-12 SEC during the EE's employment period.
- Dose Uncertainty Entered into IREP
 - Both NIOSH and SC&A assigned the occupational medical dose as a normal distribution with an uncertainty of 30%.

Effective Date: March 25, 2015	Revision No. 0 (Draft)	Document No. SCA-TR-DRC2015-CN[Redact]	Page No. 11 of 12
------------------------------------------	----------------------------------	--------------------------------------------------	-----------------------------

REFERENCES

ORAUT-OTIB-0005. 2012. *Technical Information Bulletin: Internal Dosimetry Organ, External Dosimetry Organ, and IREP Model Selection by ICD-9 Code*, Rev. 05, Oak Ridge Associated Universities Team, Cincinnati, Ohio. December 20, 2012.

ORAUT-OTIB-0006. 2011. *Technical Information Bulletin: Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures*, Rev. 04, Oak Ridge Associated Universities, Cincinnati, Ohio. June 20, 2011.

ORAUT-OTIB-0079. 2011. *Technical Information Bulletin: Guidance on Assigning Occupational X-Ray Dose under EEOICPA for X-Rays Administered Off Site*, Rev. 00, Oak Ridge Associated Universities Team, Cincinnati, Ohio. January 3, 2011.

ORAUT-TKBS-0014-3. 2007. *Technical Basis Document for the Y-12 National Security Complex – Occupational Medical Dose*, Rev. 01, Oak Ridge Associated Universities Team, Cincinnati, Ohio. June 18, 2007.

ORAUT-TKBS-0014-5. 2012. *Technical Basis Document for the Y-12 National Security Complex – Occupational Internal Dose*, Rev. 03, Oak Ridge Associated Universities Team, Cincinnati, Ohio. March 12, 2012.

ORAUT-TKBS-0014-6. 2009. *Technical Basis Document for the Y-12 National Security Complex – Occupational External Dose*, Rev. 02, Oak Ridge Associated Universities Team, Cincinnati, Ohio. December 18, 2009.

Effective Date: March 25, 2015	Revision No. 0 (Draft)	Document No. SCA-TR-DRC2015-CN[Redact]	Page No. 12 of 12
------------------------------------------	----------------------------------	--------------------------------------------------	-----------------------------

**ADDENDUM A: SC&A'S BLIND DOSE RECONSTRUCTION
REPORT OF CASE # [Redacted]**

NOTICE: This report has been reviewed for Privacy Act information and has been cleared for distribution. However, this report is pre-decisional and has not been reviewed by the Advisory Board on Radiation and Worker Health for factual accuracy or applicability within the requirements of 42 CFR 82.

Draft

**REPORT TO THE ADVISORY BOARD
ON RADIATION AND WORKER HEALTH**

National Institute for Occupational Safety and Health

**BLIND DOSE RECONSTRUCTION OF CASE # [REDACT]
FROM THE Y-12 NATIONAL SECURITY COMPLEX**

**Contract No. 211-2014-58081
SCA-TR-BDR2015-CN [Redact]**

Prepared by

Ron Buchanan, PhD, CHP
S. Cohen & Associates
1608 Spring Hill Road, Suite 400
Vienna, Virginia 22182

February 2015

NOTICE: This report has been reviewed for Privacy Act information and has been cleared for distribution. However, this report is pre-decisional and has not been reviewed by the Advisory Board on Radiation and Worker Health for factual accuracy or applicability within the requirements of 42 CFR 82.

Effective Date: February 12, 2015	Revision No. 0 (Draft)	Document No. SCA-TR-BDR2015-CN[Redact]	Page No. 2 of 12
--------------------------------------	---------------------------	-------------------------------------------	---------------------

S. Cohen & Associates: <i>Technical Support for the Advisory Board on Radiation & Worker Health Review of NIOSH Dose Reconstruction Program</i>	Document No. SCA-TR-BDR2015-CN[Redact]
	Effective Date: Draft – February 12, 2015
	Revision No. 0 (Draft)
BLIND DOSE RECONSTRUCTION OF CASE # [REDACT] FROM THE Y-12 NATIONAL SECURITY COMPLEX	Page 2 of 12
Task Manager: _____ Date: _____ Douglas Farver, CHP	Supersedes: N/A
Project Manager: _____ Date: _____ John Stiver, MS, CHP	Reviewers: Kathleen Behling Douglas Farver Rose Gogliotti

Record of Revisions

Revision Number	Effective Date	Description of Revision
0 (Draft)	02/12/2015	Document finalized. This document will be distributed as an addendum to the blind dose reconstruction comparison for this case review.

NOTICE: This report has been reviewed for Privacy Act information and has been cleared for distribution. However, this report is pre-decisional and has not been reviewed by the Advisory Board on Radiation and Worker Health for factual accuracy or applicability within the requirements of 42 CFR 82.

Effective Date: February 12, 2015	Revision No. 0 (Draft)	Document No. SCA-TR-BDR2015-CN[Redact]	Page No. 3 of 12
--------------------------------------	---------------------------	-------------------------------------------	---------------------

TABLE OF CONTENTS

1.0	Summary Background Information	4
1.1	SC&A Blind Dose Reconstruction Approach.....	4
2.0	External Doses	5
2.1	Occupational Medical Dose.....	5
3.0	Internal Doses	6
4.0	CATI Report and Radiological Incidents	7
5.0	Summary Conclusions	8
	References.....	9
	Appendix A-1: IREP Input – Lung.....	10
	Appendix A-2: IREP Input – Bone.....	11
	Appendix A-3: IREP Input – Carcinoma.....	12

NOTICE: This report has been reviewed for Privacy Act information and has been cleared for distribution. However, this report is pre-decisional and has not been reviewed by the Advisory Board on Radiation and Worker Health for factual accuracy or applicability within the requirements of 42 CFR 82.

1.0 SUMMARY BACKGROUND INFORMATION

This report presents the results of an independent blind dose reconstruction (DR) performed by S. Cohen & Associates (SC&A, Inc.) for an energy employee (EE) who worked at the National Security Complex (Y-12) from [redact] through [redact].

In [redact], the EE was diagnosed with **secondary lung cancer** (ICD-9 Code 197.0), **secondary bone cancer** (ICD-9 Code 198.5), and **unknown primary metastatic carcinoma** (ICD-9 Code 199).

According to Department of Labor (DOL) and Computer-Assisted Telephone Interview (CATI) Report, the EE was a [redact] at Y-12. The EE was not monitored for external or internal exposures.

1.1 SC&A BLIND DOSE RECONSTRUCTION APPROACH

SC&A reviewed all of the Department of Energy (DOE) records provided on behalf of this EE and the National Institute for Occupational Safety and Health (NIOSH) procedures relevant to this case, which included the Technical Basis Documents (TBDs) for Y-12 (issued as six separate documents numbered ORAUT-TKBS-0014-1 through ORAUT-TKBS-0014-6). According to the Y-12 Special Exposure Cohort (SEC), the external doses (ORAUT-TKBS-0014-6, page 12), internal doses (ORAUT-TKBS-0014-5, page 11), and environmental doses (ORAUT-TKBS-0014-4, page 9) for workers at the Y-12 facility cannot be reconstructed prior to 1948, except for occupational medical. Additionally, according to the DOL records, the EE only worked for a total of 242 days; therefore, the cancers would not be covered by the SEC.

SC&A derived the appropriate occupational medical x-ray doses as summarized in Table 1. Since the EE was diagnosed with three cancers, three sets of doses were entered into the Interactive RadioEpidemiological Program (IREP), one set for each cancer. SC&A determined the probability of causation (POC) for this case using the annual doses listed in the three IREP Input tables, as shown in Appendices A-1 through A-3 of this report. The total dose shown in Table 1 produced a POC of **49.48%**.

Table 1. Summary of SC&A-Derived External/Internal Dose Estimates

	#1 Lung IREP Entry	Dose (rem)	#2 Bone IREP Entry	Dose (rem)	#3 Carcinoma IREP Entry	Dose (rem)
External Dose (Occupational):						
▪ Recorded Photon Dose						
30–250 keV Photons	NA	–	NA	–	NA	–
▪ Missed Photon Dose						
30–250 keV Photons	NA	–	NA	–	NA	–
▪ Recorded Shallow Dose						
e ⁻ >15 keV	NA	–	NA	–	NA	–
▪ Occupational Medical Dose:	1–2	12.150	1–2	3.780	1–2	4.050
▪ Occupational Envir. Dose:	NA	–	NA	–	NA	–
Internal Dose (Occupational):	NA	–	NA	–	NA	–
Total		12.150		3.780		4.050

NOTICE: This report has been reviewed for Privacy Act information and has been cleared for distribution. However, this report is pre-decisional and has not been reviewed by the Advisory Board on Radiation and Worker Health for factual accuracy or applicability within the requirements of 42 CFR 82.

2.0 EXTERNAL DOSES

According to the Y-12 SEC, the external doses (ORAUT-TKBS-0014-6, page 12) and environmental external doses (ORAUT-TKBS-0014-4, page 9) for workers at the Y-12 facility cannot be reconstructed prior to 1948, except for occupational medical.

2.1 OCCUPATIONAL MEDICAL DOSE

This EE had two secondary cancers with unknown primaries. According to ORAUT-OTIB-0005, Table 3-2, page 29, in this case the dose reconstructor is to evaluate the potential primary cancers and use the primary cancer site that provides for the greater dose for each of the secondary cancers. Table 2 provides a summary of the three secondary cancer sites and their respective primary sites.

Table 2. Secondary Cancers and their Related Primary Cancer Sites for Medical X-rays

Secondary Cancer ICD-9 Code	Secondary Cancer	Potential Primary Cancer ICD-9 Code	Potential Primary Cancer Site*
197.0	Lung	153	Colon
		162	Lung
		172	Skin
		185	Bladder
		188	Bladder
		189	Liver
198.5	Bone	162	Lung
		185	Bladder
199	Metastatic Carcinoma	199	Remainder

*Organ that produced the greater dose is shown in bold font.

The medical x-ray doses for a photofluorography (PFG) exam for each of these potential primary organs were obtained from Table A-2, page 22, of ORAUT-TKBS-0014-3. The greater of the primary dose was assigned for the secondary cancer site. This resulted in assigning the skin dose of 4.050 rem for the lung; for the bone, the lung dose of 1.260 rem was the most claimant favorable; and for the carcinoma, the remainder dose of 1.350 rem represented the highest dose. These organs are shown in bold text in Table 2.

Using the recommendations in Table 3-1, page 9, of ORAUT-TKBS-0014-3, SC&A assigned a PFG medical x-ray exam for 1944 (EE's start date was December 6, 1944; therefore, most likely the EE would not have received a pre-placement and an annual exam in [redact]). SC&A assigned an annual and termination x-ray ([redact]) for [redact], since the EE worked most of that year. This resulted in the doses listed in the IREP Input tables, as shown in Appendices A-1 through A-3 of this report.

Effective Date: February 12, 2015	Revision No. 0 (Draft)	Document No. SCA-TR-BDR2015-CN[Redact]	Page No. 6 of 12
--------------------------------------	---------------------------	-------------------------------------------	---------------------

3.0 INTERNAL DOSES

According to the Y-12 SEC, internal doses (ORAUT-TKBS-0014-5, page 11) and environmental internal doses (ORAUT-TKBS-0014-4, page 9) for workers at the Y-12 facility cannot be reconstructed prior to 1948.

Effective Date: February 12, 2015	Revision No. 0 (Draft)	Document No. SCA-TR-BDR2015-CN[Redact]	Page No. 7 of 12
--------------------------------------	---------------------------	-------------------------------------------	---------------------

4.0 CATI REPORT AND RADIOLOGICAL INCIDENTS

SC&A reviewed the EE's DOE records and CATI Report (provided by the survivor) to determine if the EE was involved in any radiological incidents. SC&A did not find any documentation of radiological incidents that would impact the radiation doses assigned in this case.

Effective Date: February 12, 2015	Revision No. 0 (Draft)	Document No. SCA-TR-BDR2015-CN[Redact]	Page No. 8 of 12
--------------------------------------	---------------------------	-------------------------------------------	---------------------

5.0 SUMMARY CONCLUSIONS

This DR used best-estimate methods to obtain reasonable external occupational medical x-ray dose assignments. The derived doses resulted in a POC <50%.

The total POC for the three cancers was calculated using the NIOSH-IREP (v.5.7) and was determined to be **49.48%**.

Effective Date: February 12, 2015	Revision No. 0 (Draft)	Document No. SCA-TR-BDR2015-CN[Redact]	Page No. 9 of 12
--------------------------------------	---------------------------	-------------------------------------------	---------------------

REFERENCES

ORAUT-OTIB-0005. 2012. *Dosimetry Organ, External Dosimetry Organ, and IREP Model Selection by ICD-9 Code*, Rev. 05, Oak Ridge Associated Universities Team, Cincinnati, Ohio. December 20, 2012.

ORAUT-TKBS-0014-3. 2007. *Technical Basis Document for the Y-12 National Security Complex – Occupational Medical Dose*, Rev. 01, Oak Ridge Associated Universities Team, Cincinnati, Ohio. June 18, 2007.

ORAUT-TKBS-0014-4. 2006. *Technical Basis Document for the Y-12 National Security Complex – Occupational Environmental Dose*, Rev. 01, Oak Ridge Associated Universities Team, Cincinnati, Ohio. July 20, 2006.

ORAUT-TKBS-0014-5. 2012. *Technical Basis Document for the Y-12 National Security Complex – Occupational Internal Dose*, Rev. 03, Oak Ridge Associated Universities Team, Cincinnati, Ohio. March 12, 2012.

ORAUT-TKBS-0014-6. 2009. *Technical Basis Document for the Y-12 National Security Complex – Occupational External Dose*, Rev. 02, Oak Ridge Associated Universities Team, Cincinnati, Ohio. December 18, 2009.

APPENDIX A-1: IREP INPUT – LUNG

(Lung secondary => Max primary external dose organ = skin, IREP model = Melanoma)

CLAIMANT CANCER DIAGNOSES							
	Primary Cancer #1	Primary Cancer #2	Primary Cancer #3	Secondary Cancer #1	Secondary Cancer #2	Secondary Cancer #3	
Cancer Type	N/A	N/A	N/A	Lung Cancer	N/A	N/A	
Date of Diagnosis	N/A	N/A	N/A	[redact]	N/A	N/A	
EXPOSURE INFORMATION							
Number of exposures							
2							
Exposure #	Exposure Year	Exposure Rate	Radiation Type	Dose Distribution Type	Parameter 1	Parameter 2	Parameter 3
1	[redact]	acute	photons E=30–250keV	Normal	4.050	1.215	0.000
2	[redact]	acute	photons E=30–250keV	Normal	8.100	2.430	0.000

NOTICE: This report has been reviewed for Privacy Act information and has been cleared for distribution. However, this report is pre-decisional and has not been reviewed by the Advisory Board on Radiation and Worker Health for factual accuracy or applicability within the requirements of 42 CFR 82.

APPENDIX A-2: IREP INPUT – BONE

(Bone secondary => Max primary external dose organ = lung, IREP model = Lung)

CLAIMANT CANCER DIAGNOSES							
	Primary Cancer #1	Primary Cancer #2	Primary Cancer #3	Secondary Cancer #1	Secondary Cancer #2	Secondary Cancer #3	
Cancer Type	N/A	N/A	N/A	Bone Cancer	N/A	N/A	
Date of Diagnosis	N/A	N/A	N/A	[redact]	N/A	N/A	
EXPOSURE INFORMATION							
Number of exposures							
2							
Exposure #	Exposure Year	Exposure Rate	Radiation Type	Dose Distribution Type	Parameter 1	Parameter 2	Parameter 3
1	[redact]	acute	photons E=30–250keV	Normal	1.260	0.378	0.000
2	[redact]	acute	photons E=30–250keV	Normal	2.520	0.756	0.000

NOTICE: This report has been reviewed for Privacy Act information and has been cleared for distribution. However, this report is pre-decisional and has not been reviewed by the Advisory Board on Radiation and Worker Health for factual accuracy or applicability within the requirements of 42 CFR 82.

APPENDIX A-3: IREP INPUT – CARCINOMA

(Metastatic carcinoma, unknown primary => Max primary external dose organ = remainder,
IREP model = Other & ill defined sites)

CLAIMANT CANCER DIAGNOSES							
	Primary Cancer #1	Primary Cancer #2	Primary Cancer #3	Secondary Cancer #1	Secondary Cancer #2	Secondary Cancer #3	
Cancer Type	Metastatic carcinoma, unknown primary	N/A	N/A	N/A	N/A	N/A	
Date of Diagnosis	N/A	N/A	N/A	N/A	N/A	N/A	
EXPOSURE INFORMATION							
Number of exposures							
2							
Exposure #	Exposure Year	Exposure Rate	Radiation Type	Dose Distribution Type	Parameter 1	Parameter 2	Parameter 3
1	[redact]	acute	photons E=30-250keV	Normal	1.350	0.405	0.000
2	[redact]	acute	photons E=30-250keV	Normal	2.700	0.810	0.000

NOTICE: This report has been reviewed for Privacy Act information and has been cleared for distribution. However, this report is pre-decisional and has not been reviewed by the Advisory Board on Radiation and Worker Health for factual accuracy or applicability within the requirements of 42 CFR 82.