**DRAFT**

# OCAS-PER-014, SUBTASK 4

# REVIEW OF SELECT CASES REWORKED FOR THE EVALUATION OF CONSTRUCTION TRADE WORKER COWORKER DOSE

## Revision 1

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## Record of Revisions

| Revision Number | Effective Date | Description of Revision |
|---|---|---|
| 0 (Draft) | 04/12/2013 | Initial issued. |
| 1 (Draft) | 04/30/2013 | Subtask 4 finding numbers were changed to reflect a continuation of the review of OCAS-PER-014 Subtasks 1–3 (SCA-TR-PR2012-0014). After discussions with the Procedures Subcommittee, observation 3 was changed to a finding. |
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# 1.0 RELEVANT BACKGROUND INFORMATION

During a meeting of the Advisory Board on Radiation and Worker Health (Advisory Board) on October 22, 2009, SC&A was tasked by the Board to conduct a review of OCAS-PER-014, *Construction Trade Workers.* OCAS-PER-014 was initiated following the issuance of ORAUT-OTIB-0052, *Parameters to Consider When Processing Claims for Construction Trade Workers*. This document provided guidance for assessing exposure to construction trade workers (CTWs) with inadequate internal or external monitoring for radiation exposure. SC&A previously evaluated the technical adequacy of ORAUT-OTIB-0052 (SCA-TR-PR2011-0004). Thereafter, OCAS-PER-014 was issued to determine which previously completed claims required re-evaluation for the affect of ORAUT-OTIB-0052.

On March 16, 2012, SC&A submitted to the Subcommittee on Procedures Review our review of the National Institute for Occupational Safety and Health's (NIOSH's) program evaluation report (PER) OCAS-PER-014 (SCA-TR-PR2012-0014). In conducting a PER review, SC&A is committed to perform five subtasks, as specified below:

Subtask 1: Assess NIOSH's evaluation/characterization of the "issue" and its potential impacts on dose reconstruction (DR). Our assessment intends to ensure that the "issue" was fully understood and characterized in the PER.

Subtask 2: Assess NIOSH's specific methods for corrective action. In instances where the PER involves a technical issue that is supported by document(s) [e.g., white papers, technical information bulletins (TIBs), procedures] that have not yet been subjected to a formal SC&A review, Subtask 2 will include a review of the scientific basis and/or sources of information to ensure the credibility of the corrective action and its consistency with current/consensus science. Conversely, if such technical documentation has been formalized and previously subjected to a review by SC&A, Subtask 2 will simply provide a brief summary/conclusion of this review process.

Subtask 3: Evaluate the PER's stated approach for identifying the universe of potentially affected DRs, and assess the criteria by which a subset of potentially affected DRs was selected for re-evaluation. The second step may have important implications in instances where the universe of previously denied DRs is very large and, for reasons of practicality, NIOSH's re-evaluation is confined to a subset of DRs that, based on their scientific judgment, have the potential to be significantly affected by the PER. In behalf of Subtask 3, SC&A will also evaluate the timeliness for the completion of the PER.

Subtask 4: Conduct audits of DRs affected by the PER under review. The number of DRs selected for audit for a given PER will vary, based on important elements such as (1) the number of target organs/tissues that may be impacted by a PER, (2) the method/data that were employed in the original DR, and (3) the time period, work location, and job function(s) that characterize the DR of a claim. (It is assumed that the selection of the DRs and the total number of DR audits per PER will be made by the Advisory Board.)

Subtask 5: Prepare a comprehensive written report that contains the results of the above-stated subtasks, along with our review conclusions.

This report fulfills the requirement defined in Subtask 4, "Conduct audits of DRs affected by the PER under review." To determine the total population of claims that had the potential of being "affected" by ORAUT-OTIB-0052, NIOSH limited the scope to claims completed from sites that had external coworker models employed prior to the issue of ORAUT-OTIB-0052. These sites are listed in Table 1-1.

**Table 1-1. DOE Sites with External Coworker Model Issued Prior to August 31, 2006, that Must Be Evaluated under OCAS-PER-014**

| Site | First Published Coworker | |
|---|---|---|
| | Date | Document |
| Hanford | 3/23/2005 | ORAUT-OTIB-0030 |
| PNNL | 3/23/2005 | ORAUT-OTIB-0030 |
| Kansas City Plant | 5/31/2005 | ORAUT-TKBS-0031 |
| LANL | 5/10/2005 | ORAUT-TKBS-0010-6 |
| Pantex Plant | 7/27/2006 | ORAUT-TKBS-0013-6 |
| Portsmouth Gaseous Diffusion Plant (PGDP) | 7/29/2005 | ORAUT-OTIB-0040 |
| SRS | 5/31/2005 | ORAUT-OTIB-0032 |
| Weldon Spring Plant | 6/24/2005 | ORAUT-TKBS-0028-6 |
| ORNL (X-10) | 12/29/2004 | ORAUT-OTIB-0021 |
| Y-12 Plant | 9/9/2004 | ORAUT-OTIB-0013 |

NIOSH then implemented a keyword search for 31 CTW job functions to define the universe of potentially affected claims. Using this search method, NIOSH identified a total of 977 potentially affected cases. The following criteria were then used for each case:

(1) External coworker dose was assigned.

(2) Verify the claim involves a CTW.

(3) Determine if the probability of causation (POC) is less than the trigger values, 36.8% or 29.0% for Hanford.

(4) Verify no other PERs affect the claim. If there is no increase in dose based on other PERs, the claim does not need a new DR.

The application of ORAUT-OTIB-0052, under the most conservative assumption (i.e., when the organ dose/POC was exclusively based on external coworker dose), can be increased by a factor of 1.4 for non-Hanford cases and 2.0 for Hanford claims. Thus, for the revised POC of 45% as a screening criterion, any of the 4,865 claims with POCs less than 16.97% can be eliminated from further consideration, as shown in Equation 1 below:

$$POC = \frac{ERR}{1 + ERR} \; x \; 100 \qquad \text{Eq. 1}$$

For a revised POC to reach 45%, the Excess Relative Risk (ERR) must equal 0.81818, or 4 times the original ERR value of 0.20454, which corresponds to the original POC of 36.8% for non-Hanford cases and 29.0% for Hanford Cases.

SC&A's review of OCAS-PER-014, Subtasks 1 through 3, resulted in the identification of 6 findings. All findings were closed prior to the start of this Subtask 4 review. However, it should be noted that although SC&A concluded that the selection and screening criteria of claims described in Section 3.0 of OCAS-PER-014 are scientifically sound, these criteria may not be inclusive of all potentially affected claims. SC&A identified the following instances that may be missed by the screening criteria (SCA-TR-PR2012-0014, pg. 16):

- *Claims representing CTWs who were **un**monitored or inadequately monitored and whose DR was adjudicated **before** the issue date of the site-specific external coworker (as well as the internal coworker) model.*

- *For CTW claims completed/adjudicated before the issuance of a coworker model(s), DR for the unmonitored CTW would have been limited to environmental dose and possible medical dose with resultant POC values that would likely be well **below** the trigger PC values of 38.6% (and 29% for Hanford) and, therefore, be excluded from further consideration.*

- *Even for those CTW claims that exceed the POC trigger value, the **absence** of an assigned coworker dose excludes the eligibility of these claims for a new DR.*

At the time of SC&A's review, the screening criteria had not been applied to the initial 977 cases identified as potentially impacted by ORAUT-OTIB-0052. When applied, the screening criteria eliminated 925 cases from further consideration. Notably of the 925 cases, 221 cases were returned to NIOSH because of another PER, and 84 cases were returned to NIOSH for other reasons. These cases will be subject to re-evaluation, taking into account ORAUT-OTIB-0052; however, since they were already being re-evaluated, they do not need to be re-accounted for by OCAS-PER-014. Therefore, it was necessary for NIOSH to perform a dose re-evaluation for 52 claims from among the initial 977 cases.

To satisfy Subtask 4, SC&A indicated the need for dose re-evaluation for all 10 sites listed in Table 1-1. This was discussed further at the Procedures Review Subcommittee meeting held in Cincinnati, Ohio, on July 31, 2012. At the meeting, it was decided that SC&A would review 1 case, revised to incorporate ORAUT-OTIB-0052, from each site listed in Table 1-1 (10 cases total). During the course of this review, SC&A was tasked with also evaluating the site technical basis document (TBD) and applicable workbooks to ensure they were properly updated to incorporate ORAUT-OTIB-0052's CTW coworker recommendations. If any site did not have a case that was revised specifically because of ORAUT-OTIB-0052, cases could be pulled from the 305 cases that were revised to incorporate ORAUT-OTIB-0052 outside of OCAS-PER-014. If no case was modified for any site, SC&A was asked to review the TBD guidance and applicable workbooks for the site.

It was determined by the Procedures Review Subcommittee that SC&A's audit of selected DRs should be limited to (1) evaluating those methods and corrective actions introduced in the reworked DRs that relate strictly to issues addressed in OCAS-PER-014, and (2) evaluating applicable TBD documentation and workbooks to ensure they properly reflect the recommendations of ORAUT-OTIB-0052. Presented in Sections 3 through 12 is SC&A focused review to determine whether reworked coworker CTW doses were appropriately handled.

# 2.0 EVALUATION OF SELECTION CRITERIA EXECUTION

At the time SC&A reviewed OCAS-PER-014 (SCA-TR-PR2012-0014), the selection criteria had not yet been applied to the 977 potentially impacted cases. Thereafter, this process was completed and SC&A received a list of the 977 claims potentially impacted with selection criteria applied. Using this list, SC&A generated the following two tables.

**Table 2-1. Selection Criteria Applied to Potentially Affected Cases**

| Result of Selection Criteria | Meaning of Designation | Cases Affected |
|---|---|---|
| No Return Necessary | NIOSH requested that the case NOT be returned for a new DR | 620 |
| Return Requested for Another PER | NIOSH requested the case be returned based on a different PER | 221 |
| Returned to NIOSH | NIOSH requested the case be returned for a new DR | 52 |
| Returned Prior to Evaluation | Case was returned to NIOSH prior to completing the PER evaluation | 84 |
| **Total** | | 977 |

**Table 2-2. Selection Criteria per Site**

| Site | Total Number of Claims[a] | Returned to NIOSH | Return Requested for Another PER | Returned Prior to Evaluation | No Return Necessary |
|---|---|---|---|---|---|
| Hanford | 166 | 14 | 80 | 14 | 58 |
| PNNL | 18 | 0 | 8 | 3 | 7 |
| Kansas City Plant | 56 | 5 | 1 | 0 | 50 |
| LANL | 49 | 1 | 29 | 9 | 10 |
| Pantex Plant | 1 | 0 | 1 | 0 | 0 |
| PGDP | 112 | 4 | 2 | 4 | 102 |
| SRS | 162 | 5 | 61 | 29 | 67 |
| Weldon Spring | 19 | 1 | 1 | 0 | 17 |
| ORNL (X-10) | 159 | 10 | 41 | 28 | 80 |
| Y-12 | 392 | 24 | 44 | 25 | 299 |

[a] 258 cases had employment at 2 or more sites. These cases are included in the site totals and potentially appear in multiple site totals.

While SC&A was selecting cases to review as part of Subtask 4, it was discovered that many of the 52 cases identified as "Return to NIOSH" were not revised. Further investigation revealed that many of these cases did not meet the selection criteria to be included in the subset, as discussed in Finding 7 below. (Please note that, since the review under Subtasks 1–3 identified 6 findings, the first Subtask 4 finding will begin with number 7.)

**Finding 7: Application of Selection Criteria in Question**

SC&A found that many of the cases identified as requiring rework did not meet all requirements of the selection criteria that should have been used to define the cases that needed to be evaluated. For instance, 5 Kansas City Plant (KCP) cases were included in the set of 52 cases requiring rework. None of these five cases had a POC greater than the selection criteria of 36.8%; therefore, none of the five DRs were revised. Inclusion of cases that did not meet the selection criteria was **not limited** to Kansas City cases or POC selection criteria cases. SC&A questions why cases that did not meet the selection criteria were included in the set of cases

requiring re-evaluation. Furthermore, if the criteria were not applied correctly to this subset, SC&A remains concerned that they not have been appropriately applied elsewhere.

## Finding 8: Not All Cases "Returned to NIOSH" Were Re-evaluated

Cases that are returned to NIOSH as a result of a PER are revised using the most current technical guidance. Because it is assumed that **all** cases returned are completely updated, these cases are no longer eligible for rework under other PER evaluations that occurred at about the same time. During the course of this review, SC&A noted that some cases were returned to NIOSH as a result of OCAS-PER-014, yet were **not** revised. Although these cases were not revised due to OCAS-PER-014, they were nonetheless precluded from revision under other recently issued relevant PERs presumably because they were returned to NIOSH for OCAS-PER-014. This is potentially indicative of a larger issue that encompasses all PER evaluations. To SC&A's knowledge, there is no designation for cases that were returned to NIOSH yet not revised that would allow them to re-enter the pool of cases eligible for re-evaluation. Thus, there is a possibility that all cases that are returned and not revised have been missed inadvertently by subsequent PER evaluations. NIOSH needs to investigate this issue further.

# 3.0 REVIEW OF OCAS-PER-014 ISSUES RELATED TO SAVANNAH RIVER SITE

## 3.1 SAVANNAH RIVER SITE CASE SELECTION

OCAS-PER-014 identified 162 Savannah River Site (SRS) claims as potentially impacted by ORAUT-OTIB-0052. Of these claims, only five were sent back to NIOSH for revision. SC&A selected Case #[redacted] at random from these five cases. Prior to evaluation, SC&A confirmed this case was revised to include CTW dose.

## 3.2 BACKGROUND INFORMATION FOR CASE #[REDACTED]

Case #[redacted] represents an energy employee (EE) who worked at the SRS during [redacted], through [redacted]. The EE's job function during employment was a construction worker from 1952 to 1955 and [redacted] worker from 1956 to 1983.

The EE was monitored for external photon exposures during 1959–1983 and neutron exposures during 1971–1983. The EE was unmonitored prior to this time. Internal exposure monitoring was also conducted by means of whole-body counting and occasional in-vitro urinalysis bioassays. The EE was diagnosed with prostate cancer (ICD Code 185.0) on January 9, 1988.

## 3.3 COMPARISON OF NIOSH'S ORIGINAL AND REWORKED DOSE RECONSTRUCTION

NIOSH performed the original DR of Case #[redacted] in May 2006. The claim was reworked in May 2009 to evaluate the potential for additional dose based on new guidance for processing claims of construction workers. Both the original and revised DRs stated that the EE's radiation dose was overestimated using efficiency measures. In the original DR, NIOSH calculated a dose of 74.424 rem to the prostate. Based on this assigned dose estimate, the Department of Labor (DOL) determined the POC to be 43.49% and the claim was denied.

Using the most current technical guidance documents, NIOSH recalculated a prostate dose of 78.254 rem in the revised DR. Table 3-1 provides a comparison of the original and revised external and internal organ dose estimates for the prostate. It should be noted that the values cited in Table 3-1 were extracted directly from NIOSH's reworked DR. With the exception of potential coworker external dose, SC&A has not assessed the accuracy or correctness of these doses, since performing such an assessment is beyond the scope of this Subtask 4 report.

**Table 3-1. Comparison of NIOSH-Derived External/Internal Dose Estimates Assigned for the Prostate in the Original and Reworked DRs for Case #[Redacted]**

| Dose Categories | Previous Dose (rem) | Revised Dose (rem) |
|---|---|---|
| External Measured and Missed | 55.454 | 56.052 |
| External Coworker | 12.862 | 13.998 |
| Ambient External | 2.719 | 2.721 |
| Medical X-ray | 0.346 | 0.380 |
| Internal | 3.043 | 5.103 |
| **Total** | **74.424** | **78.254** |

Using the EE's Department of Energy (DOE) records and claimant-favorable assumptions, a prostate dose of 78.254 rem resulted in a POC of 44.85%, and on this basis, the revised claim was denied.

## 3.4 SC&A'S REVIEW OF OCAS-PER-014 ISSUES RELATED TO CASE #[REDACTED]

As directed by the Procedures Review Subcommittee, SC&A's review of Case #[redacted] strictly focused on external coworker models for CTWs. Case #[redacted] was included in the pool of claims that required the DR to be reworked because it met the OCAS-PER-014 criteria of (1) original DR was performed prior to August 31, 2006, (2) the EE worked as a CTW, (3) coworker dose was assigned, and (4) the POC was less than 50% but greater than 36.8%. This case was selected for review by SC&A because it represented application of CTW coworker dose at SRS.

The EE was unmonitored for external exposure until 1959. In the **original** DR, NIOSH identified the time period 1952–1955 as the time when the EE was performing non-radiological work. During this period, NIOSH assigned a 50$^{th}$ percentile coworker photon dose. During the remainder of the period for which the EE was not monitored for external exposure (1956–1959), NIOSH identified the EE as being at high risk of exposure due to the presence of routine internal monitoring records and assigned the 95$^{th}$ percentile coworker photon dose. NIOSH assumed the EE was exposed to 100% 30–250 keV photons and applied a 1.119 correction factor (CF), as recommended by the SRS TBD. After 1959, the EE was routinely monitored for external exposure, so no coworker dose was assigned. This resulted in a total photon unmonitored coworker dose of 12.862 rem.

In the **reworked** DR, NIOSH identified two distinct periods during the time the EE was unmonitored for external exposure, which included (1) 1956–1959, when the EE was monitored internally, and (2) 1952–1955, when the EE was not monitored. Based on the Computer-Assisted Telephone Interview (CATI) report and DOE files, it is unclear the exact time period the EE worked as a construction worker and when the EE began working in operations. The CATI indicates the EE started work as a construction worker for a few years, then worked in operations for the remainder of the employment period. NIOSH assumed that the EE was a construction worker during the years that the EE was unmonitored both internally and externally. SC&A believes this is a reasonable and likely assumption, lacking other evidence to the contrary. NIOSH used Table 3 of ORAUT-OTIB-0032, *External Coworker Dosimetry Data for the Savannah River Site*, to assign the 50$^{th}$ percentile SRS CTW coworker dose. NIOSH assumed

the EE was exposed to 100% 30–250 keV photons and applied a CF of 1.119, as recommended by the SRS TBD. The 1952 coworker dose was prorated to account for a partial year of employment, and the dose for 1952–1955 was adjusted using the appropriate maximizing dose conversion factor (DCF) for the prostate. The remaining unmonitored dose for the years 1956–1959 was unchanged from the original DR, because it was determined that the EE was not a CTW during this time. Using the updated CTW coworker modeling, a total coworker dose of 13.998 rem was assigned to the prostate.

In evaluating this case, SC&A compared the guidance provided in ORAUT-OTIB-0052 for assessing unmonitored CTW coworker dose with the guidance from the SRS External Coworker TIB (ORAUT-OTIB-0032). For the convenience of the reader, ORAUT-OTIB-0052 guidance is cited below:

> *Use the guidance in ORAUT-OTIB-0020 (ORAUT 2008) to assign a penetrating dose that is favorable to unmonitored CTWs. Apply an adjustment factor of 1.4 to the appropriate percentile of the measured coworker data for the site, plus the assigned coworker missed dose, to determine the total assigned penetrating dose that is favorable to unmonitored CTWs.*

SC&A reviewed ORAUT-OTIB-0032, which was revised on November 7, 2006, due to the issuance of ORAUT-OTIB-0052. The revision added Table 3 for CTW coworker dose. It was found that missed and measured doses are reported in a single value for each percentile of coworker dose and, therefore, an adjustment of 1.4 could not be applied directly.

SC&A requested that NIOSH provide separate values for missed and measure coworker doses from Table 2 of ORAUT-OTIB-0032, so that SC&A could independently confirm that the guidance from ORAUT-OTIB-0052 was properly executed and recorded in Table 3. NIOSH was unable to provide these values to SC&A during the course of SC&A's review of OCAS-PER-014. Because these values were unavailable, SC&A preformed a cursory check of the values assuming NIOSH properly executed the 1.4 adjustment to measured dose. SC&A found the following to be true for each year and percentile:

(CTW dose – Coworker dose)/ 0.4 = Measured dose
Coworker dose – Measured dose = Missed dose
Measured dose *1.4+ Missed dose = CTW dose

**Finding 9: SC&A Could Not Conclusively Confirm the CTW Adjustment Factor Was Properly Applied to Measured Dose at Savannah River Site**

Although our above-cited cursory check of the application of the 1.4 adjustment factor is true for the values presented in Tables 2 and 3 of ORAUT-OTIB-0032, it cannot be used to prove conclusively that the adjustment was properly made, because there are many possible combinations of adjustment factors to missed and measured doses that could yield the final adjusted values listed in Table 3. Source data are needed to conclusively show the adjustment was correctly preformed.

SC&A obtained the SRS Dose Calculation Workbook (Version 1.63) used by the dose reconstructor to calculate unmonitored coworker dose for Case #[redacted]. SC&A found that the "Coworker Dose" Tab was properly updated to include CTW coworker dose for the 99th, 95th, and 50th percentiles. SC&A confirmed that these values also matched the values listed in Tables 2 and 3 of ORAUT-OTIB-0032. SC&A verified that NIOSH selected the proper years of 50th percentile CTW coworker dose in the workbook. Using the values from Table 3 and assuming 100% 30–250 keV photons and a CF of 1.119, SC&A calculated the 50th percentile CTW coworker dose from the years 1952–1955. SC&A's calculated values match those listed in IREP Table entries #75–#78.

SC&A believes that NIOSH's DR assumptions were appropriate and claimant favorable and the data were entered into all workbooks correctly. SC&A also verified the IREP input, which indicated that the doses were entered with the appropriate distribution and uncertainty parameters. Although it appears that the rework was done in accordance with guidance provided in ORAUT-OTIB-0052, SC&A can only conclusively verify that the 1.4 adjustment factor was accurately applied to CTW doses if we have a breakdown of missed versus measured external dose.

# 4.0 REVIEW OF OCAS-PER-014 ISSUES RELATED TO OAK RIDGE NATIONAL LABORATORY X-10

## 4.1 OAK RIDGE NATIONAL LABORATORY X-10 CASE SELECTION

OCAS-PER-014 identified 159 Oak Ridge National Laboratory (ORNL) X-10 claims as potentially impacted by ORAUT-OTIB-0052. Of these claims, only 10 were sent back to NIOSH for revision. Each of these claims had two or more other employment sites also associated with it. From these claims, SC&A selected Case #[redacted] at random. Prior to the evaluation, SC&A confirmed this case was revised to include CTW dose.

## 4.2 BACKGROUND INFORMATION FOR CASE #[REDACTED]

Case #[redacted] represents an EE who worked at the ORNL X-10 site during [redacted], through [redacted]. The EE also worked at the Oak Ridge Y-12 Plant and the Gaseous Diffusion Plant (K-25) from [redacted], through [redacted]. The CATI report and DOE files indicate the EE was an [redacted] throughout employment.

The EE was not monitored for internal or external exposure prior to 1980. The EE was monitored for the intake of radioactive materials by chest and whole-body counts beginning in 1989. The EE was diagnosed with prostate cancer (ICD Code 185) on October 6, 1998.

## 4.3 COMPARISON OF NIOSH'S ORIGINAL AND REWORKED DOSE RECONSTRUCTIONS

NIOSH performed the original DR of Case #[redacted] in June 2005. The claim was reworked in January 2010, based on current practices used in DR. This was predominately done to incorporate changes in coworker dose; however, updates were also made to incorporate Type

Super S plutonium and revisions to missed dose methodology. The original DR stated that the EE's radiation dose was overestimated using claimant-favorable assumptions. The revised DR states that the DR was done using a best-estimate approach. In the original DR, NIOSH calculated a dose of 47.070 rem to the prostate. Based on this assigned dose estimate, the DOL determined the POC to be 44.52% and the claim was denied.

Using the most current technical guidance documents and considering CTW coworker dose modifications, NIOSH calculated a prostate dose of 14.246 rem in the revised DR. Table 4-1 provides a comparison the original and revised external and internal organ dose estimates for the prostate. It should be noted that the values cited in Table 4-1 were extracted directly from NIOSH's reworked DR. With the exception of external CTW coworker doses, SC&A has not assessed the accuracy or correctness of these doses, since performing such an assessment is beyond the scope of this Subtask 4 report.

**Table 4-1. Comparison of NIOSH-Derived External/Internal Dose Estimates Assigned for the Prostate in the Original and Reworked DRs for Case #[Redacted]**

| Dose Categories | Previous Dose (rem) | Revised Dose (rem) |
|---|---|---|
| External Measured and Missed | 0.628 | 0.311 |
| External Coworker | 30.422 | 13.438 |
| Medical X-ray | 0.232 | 0.308 |
| Internal | 15.788 | 0.189 |
| **Total** | **47.070** | **14.246** |

Using the EE's DOE records and best-estimate assumptions, a prostate dose of 14.246 rem resulted in a POC of 24.14%, and on this basis, the revised claim was denied.

## 4.4 SC&A'S REVIEW OF OCAS-PER-014 ISSUES RELATED TO CASE #[REDACTED]

As directed by the Procedures Review Subcommittee, SC&A's review of Case #[redacted] is strictly focused on external coworker models for CTW. Case #[redacted] was included in the pool of claims that required the DR to be reworked because it met the OCAS-PER-014 criteria of (1) original DR was performed prior to August 31, 2006, (2) the EE worked as a CTW, (3) coworker dose was assigned, and (4) the POC was less than 50% but greater than 36.8%. This case was selected by SC&A because it represented an individual who likely received unmonitored CTW dose at X-10.

The EE was unmonitored until 1980. In the **original** DR, NIOSH identified that the EE was likely exposed to external radiation prior to 1980. During this period, NIOSH assigned a 95$^{th}$ percentile coworker photon dose. Since the EE worked at X-10, Y-12, and K-25 sites, NIOSH evaluated 95$^{th}$ percentile coworker dose from the three sites and assigned the highest to the EE as the yearly coworker dose.

In the **reworked** DR, NIOSH identified that the EE qualified as a CTW with some risk of exposure. Based on the CATI report and DOE files, it is unclear at what times the EE worked at each of the three sites. NIOSH, using best-estimate rather than maximizing assumptions, compared the 50$^{th}$ percentile CTW coworker dose from ORAUT-OTIB-0021, Table 3; ORAUT-

OTIB-0064, Table 7-2; and ORAUT-OTIB-0026, Table 3. NIOSH then did a yearly comparison and assigned the highest CTW coworker dose to each year. From 1962 to 1974, K-25 50$^{th}$ percentile CTW coworker doses yielded the highest dose and were assigned to the prostate. From 1975 to 1979, X-10 coworker doses yielded the highest dose and were assigned to the prostate. This resulted in a total CTW coworker dose of 13.348 rem.

SC&A could not find guidance on how coworker dose should be assigned when the EE worked at multiple sites simultaneously. However, SC&A believes that the method used by NIOSH to assign coworker dose from the three sites simultaneously is claimant favorable and consistent with other dose-estimating protocols used in DR.

In evaluating this case, SC&A compared the guidance provided in ORAUT-OTIB-0052 for assessing unmonitored CTW coworker dose with the guidance from the Oak Ridge External Coworker TIBs (ORAUT-OTIB-0021, ORAUT-OTIB-0026, and ORAUT-OTIB-0064). Each site is discussed independently below for clarity.

**X-10:** SC&A reviewed the X-10 External Coworker TIB (ORAUT-OTIB-0021), which was revised on November 7, 2006, due to the issuance of ORAUT-OTIB-0052. The revision added Table 3 for CTW coworker dose at X-10. It was found that missed and measured doses are reported as a single value for each percentile of coworker dose. Therefore, an adjustment of 1.4 could not be applied directly.

SC&A requested that NIOSH provide separate values for missed and measure coworker doses from Table 2, so that we could independently confirm that the guidance from ORAUT-OTIB-0052 was properly implemented and recorded in Table 3 of ORAUT-OTIB-0021. NIOSH was unable to provide these values to SC&A during the course of our review of OCAS-PER-014.

**K-25:** SC&A reviewed the K-25 External Coworker TIB (ORAUT-OTIB-0026), which was revised on November 15, 2006. The revision added Table 3 for CTW coworker dose at K-25. It was found that missed and measured doses are reported as a single value for each percentile of coworker doses. Therefore, an adjustment of 1.4 could not be applied directly.

SC&A requested that NIOSH provide separate values for missed and measure coworker doses from Table 2, so that SC&A could independently confirm that the guidance from ORAUT-OTIB-0052 was properly implemented and recorded in Table 3. NIOSH was unable to provide these values to SC&A during the course of our review of OCAS-PER-14.

**Y-12:** SC&A reviewed the Y-12 External Coworker TIB (ORAUT-OTIB-0064) and found that missed and measured doses are reported in a single value for each percentile of coworker dose. Because of this, an adjustment of 1.4 cannot be applied directly. Unlike the K-25 and X-10 TIBs, ORAUT-OTIB-0064 was issued as a replacement to ORAUT-OTIB-0013 after the publication of ORAUT-OTIB-0052. In ORAUT-OTIB-0064, Tables 7-1b and 7-1c contain coworker dose, and Table 7-2 contains CTW coworker dose. It was found that missed and measured doses are reported as a single value for each percentile of coworker dose. Therefore, an adjustment of 1.4 cannot be applied directly.

SC&A requested that NIOSH provide separate values for missed and measure coworker dose from Tables 7-1b and 7-1c, so that SC&A could independently confirm that the guidance from ORAUT-OTIB-0052 was properly implemented and recorded in Table 7-2 of ORAUT-OTIB-0064. NIOSH was unable to provide these values to SC&A during the course of SC&A's review of OCAS-PER-014.

Because separated missed and measured coworker dose data were unavailable, SC&A performed a cursory check of the values assuming NIOSH properly executed the 1.4 adjustment to measured dose for each of the three sites. SC&A found the following to be true for each site, year, and percentile:

(CTW dose – Coworker dose)/0.4 = Measured dose
Coworker dose – Measured dose = Missed dose
Measured dose *1.4 + Missed dose = CTW dose

**Finding 10: SC&A Could Not Conclusively Confirm the CTW Adjustment Factor Was Properly Applied to Measured Dose at X-10, Y-12, and K-25**

Although our above-cited cursory check of the application of the 1.4 adjustment factor is true for the values presented in the coworker and CTW coworker models for ORNL sites X-10, Y-12, and K-25, it cannot be used to prove conclusively that the adjustment was properly applied for any of the three sites, because there are many possible combinations of adjustment factors to missed and measured doses that could yield the final adjusted values for each site's CTW coworker doses. Source data are needed to conclusively show that the adjustment was correctly applied.

SC&A reviewed the EE's files and found that only the Y-12 calculation workbook was included in the EE's files. The workbook was version 1.16 and does not have a tab for coworker dose. Instead, NIOSH used a manually created workbook, "External Calcs_006579," to compare CTW coworker dose for each year. SC&A compared the values listed in this table with the corresponding values from ORAUT-OTIB-0021, Table 3; ORAUT-OTIB-0064, Table 7-2; and ORAUT-OTIB-0026, Table 3 and found them to match. The highest yearly 50$^{th}$ percentile CTW doses from the three sites were selected to represent the EE's CTW coworker dose. Using the 50$^{th}$ percentile values from this selection and assuming 100% 30–250 keV photons and an organ DCF of 1.244, SC&A calculated the 50$^{th}$ percentile CTW coworker dose from the years 1962–1979. SC&A's calculated values match those listed in IREP Table entries #1–#18.

SC&A was able to verify that NIOSH's assumptions were appropriate and claimant favorable and that data were entered into all workbooks correctly. SC&A also verified the IREP input, which indicated that the doses were entered with the appropriate dose distribution and uncertainty parameters. Although it appears that the rework was done in accordance with guidance provided in ORAUT-OTIB-0052, SC&A can only conclusive verify that the 1.4 adjustment factor was accurately applied to CTW doses if we have a breakdown of missed versus measured external dose.

# 5.0 REVIEW OF OCAS-PER-014 ISSUES FOR PORTSMOUTH GASEOUS DIFFUSION PLANT

## 5.1 PORTSMOUTH CASE SELECTION

OCAS-PER-014 identified 112 Portsmouth Gaseous Diffusion Plant (PGDP) claims as potentially impacted by ORAUT-OTIB-0052. Of these claims, only four were sent back to NIOSH for revision, and only two of these claims were actually revised to include CTW coworker dose. From these two claims, SC&A selected Case #[redacted] at random. Prior to evaluation, SC&A confirmed that this case was revised to include coworker dose.

## 5.2 BACKGROUND INFORMATION FOR CASE #[REDACTED]

Case #[redacted] represents an EE who worked at PGDP during [redacted], to [redacted]. The EE worked as a [redacted] during this time. No information concerning the EE's work location is available in the CATI report or DOE records. The EE has no available internal or external monitoring results. The EE was diagnosed with [redacted] cases of squamous cell carcinoma (SSC) (skin cancer) on the scalp (ICD Code 162) between 1989 and 1996. These cancers are summarized in Table 5-1.

**Table 5-1. Summary of Case #[Redacted] Cancers**

| |
|---|
| This table has been [redacted] in full. |

## 5.3 COMPARISON OF NIOSH'S ORIGINAL AND REWORKED DOSE RECONSTRUCTION

NIOSH performed the original DR of Case #[redacted] in April 2006. The claim was reworked in October 2008 to re-evaluate this case based on new guidance on assigning CTW coworker dose. Both the original and revised DRs stated that the EE's radiation dose was overestimated using claimant-favorable assumptions. In the original DR, NIOSH calculated skin doses of 16.854 rem (1989 diagnosis), 17.259 rem (1991 diagnosis), 17.460 rem (1992 diagnosis), and 18.253 rem (1996 diagnosis). Based on this assigned dose estimate, the DOL determined the POC to be 36.79% and the claim was denied.

Using the most current technical guidance documents and considering new CTW coworker dose guidance, NIOSH recalculated a dose ranging from 1.068 to 1.102 rem to the skin in the revised DR. Table 5-2 provides a comparison the original and revised external and internal organ dose estimates for the skin. It should be noted that the values cited in Table 5-2 were extracted directly from NIOSH's reworked DR. With the exception of external CTW coworker dose,

SC&A has not assessed the accuracy or correctness of these doses, since performing such an assessment is beyond the scope of this Subtask 4 report

**Table 5-2. Comparison of NIOSH-Derived External/Internal Dose Estimates Assigned for the Skin in the Original and Reworked DRs for Case #[Redacted]**

| Dose Categories | Previous Dose (rem) | Revised Dose (rem) |
|---|---|---|
| Unmonitored External | 2.495 | 0.909 |
| Medical X-ray | 5.265 | 0.008 |
| Internal | 9.094–10.493 | 0.151–0.185 |
| **Total** | **16.856–18.253** | **1.068–1.102** |

Using the EE's DOE records and claimant-favorable assumptions, a skin dose ranging from 1.068 rem to 1.102 rem resulted in a POC of 4.07% and, on this basis, the revised claim was denied.

## 5.4 SC&A'S REVIEW OF OCAS-PER-014 ISSUES RELATED TO CASE #[REDACTED]

As directed by the Procedures Review Subcommittee, SC&A's review of Case #[redacted] strictly focused on external coworker models. Case #[redacted] was included in the pool of claims that required the DR to be reworked because it met the OCAS-PER-014 criteria of (1) the original DR was performed prior to August 31, 2006, (2) the EE worked as a CTW, (3) coworker dose was assigned, and (4) the POC was less than 50% but greater than 36.8%. This case was selected by SC&A because it represented an individual who likely received unmonitored CTW dose at PGDP.

The EE was unmonitored during the entire year of employment. In the **original** DR, NIOSH identified that the EE was potentially exposed to external photons, electrons, and neutrons. NIOSH assumed the EE was likely exposed to 100% 30–250 keV photons and assumed a DCF equal to 1.00. No photon adjustment factor was applied. NIOSH assigned each cancer the 95$^{th}$ percentile coworker photon dose from 1954. This resulted in a total photon dose of 1.736 rem to each cancer site. Since the EE's cancer originated in the skin, unmonitored external >15 keV electron dose was also assigned. NIOSH assigned the PGDP 95$^{th}$ percentile non-penetrating dose to each skin cancer. This resulted in a coworker dose of 0.055 rem from electrons to each skin cancer location. No workers at PGDP were monitored for external neutron exposure prior to 1996. In order to estimate neutron dose to the EE, NIOSH multiplied the annual photon coworker dose by 0.20. This resulted in a total modeled neutron dose based on coworker photon doses of 0.704 rem.

In the **reworked** DR, NIOSH identified that the EE qualified as a CTW with some risk of exposure. Based on the CATI report and DOE files, it is unclear where on the site the EE worked and the type of work the EE performed as a [redacted]. NIOSH compared the 50$^{th}$ percentile CTW coworker dose from ORAUT-OTIB-0040, Table 8-3. Notably, this is a smaller percentile than was used in the original maximizing DR. NIOSH assumed the EE was likely exposed to 100% 30–250 keV photons and applied an adjustment factor of 1.165, as recommended by the site external dose TBD (ORAUT-TKBS-0015-6). This resulted in a CTW

coworker dose of 0.909 rem to each skin cancer. No external coworker electron or neutron dose was assigned in the reworked DR. The DR states that, given the early era of employment, it is unlikely the EE had significant exposure potential.

As part of this Subtask 4 report, SC&A reviewed the PGDP guidance, ORAUT-OTIB-0040, which was revised on November 7, 2006, to include an additional table (Table 8-3) for calculation of coworker dose to CTWs. It was found that missed and measured doses are reported as a single value for each percentile of coworker dose in Table 8-2. Therefore, an adjustment of 1.4 cannot be applied directly to the values in Table 8-2.

SC&A requested that NIOSH provide separate values for missed and measure coworker doses from Table 8-2, so that SC&A could independently confirm that the guidance from ORAUT-OTIB-0052 was properly implemented and recorded in Table 8-3. NIOSH was unable to provide these values to SC&A during the course of SC&A's review of OCAS-PER-014.

Because separated missed and measured coworker dose data were unavailable, SC&A preformed a cursory check of the values, assuming NIOSH properly executed the 1.4 adjustment to the 95$^{th}$ and 50$^{th}$ percentiles. SC&A found the following to be true for each year and percentile:

(CTW dose – Coworker dose)/0.4 = Measured dose
Coworker dose – Measured dose = Missed dose
Measured dose *1.4 + Missed dose = CTW dose

**Finding 11: SC&A Could Not Conclusively Confirm the CTW Adjustment Factor Was Properly Applied to Measured Dose at Portsmouth**

Although our above-cited cursory check of the application of 1.4 adjustment factor is true for the values presented in the coworker and CTW coworker models in Tables 8-2 and 8-3, it cannot be used to prove conclusively that the adjustment was properly implemented, because there are many possible combinations of adjustment factors to missed and measured doses that could yield the final adjusted values for the CTW coworker dose. Source data are needed to conclusively show that the adjustment was correctly applied. Notably, if the adjustment was applied correctly, more than 70% of the measured coworker doses for the 50$^{th}$ percentile are 0.000 rem, because the CTW and non-CTW coworker doses are equal.

To calculate CTW coworker photon dose, NIOSH used the Portsmouth Calculation Workbook (version 1.21). As part of this Subtask 4 review, SC&A verified that the workbook was properly updated to incorporate the guidance from ORAUT-OTIB-0052. Coworker doses from the 95$^{th}$ and 50$^{th}$ percentile CTW coworker photon dose were both updated to include the guidance from ORAUT-OTIB-0052. SC&A confirmed that all CTW coworker percentile values match the values listed in Table 8-3 of ORAUT-OTIB-0040.

**Observation #1**

SC&A questions the applicability of applying a photon dosimetry CF of 1.165 to the entire CTW coworker dose. ORAUT-TKBS-0015-6, Table 6-26, recommends multiplying the reported

dosimeter dose by a factor of 1.165 before 1981. The CTW dose is actually a combination of missed and measured dose. This potentially overestimates dose to the EE.

SC&A found that, although NIOSH did not assign electron coworker dose during 1954, the non-penetrating 50$^{th}$ percentile coworker dose at that time was zero. This would not add additional dose to any of the cancer sites. SC&A concurs that this was correctly omitted from the revised DR. SC&A does have a concern that NIOSH omitted unmonitored neutron dose from the revised DR. Since no workers at PGDP were monitored for neutron exposure in 1954, NIOSH apparently concluded that the EE had no potential for neutron exposure during that year. SC&A does not believe that a lack of documented monitoring results alone is sufficient evidence for concluding that there was no potential neutron exposure to the EE. However, we understand that further investigation is outside the scope of this review.

SC&A was able to verify that most of NIOSH's assumptions were appropriate and claimant favorable and that data were entered into all workbooks correctly. SC&A also verified the IREP input, which indicated that the doses were entered with the appropriate dose distribution and uncertainty parameters. Although it appears that the rework was done in accordance with guidance provided in ORAUT-OTIB-0052, SC&A can only conclusively verify that the 1.4 adjustment factor was accurately applied to CTW doses if we have a breakdown of missed versus measured external dose.

# 6.0 REVIEW OF OCAS-PER-014 ISSUES FOR LOS ALAMOS NATIONAL LABORATORY

## 6.1 LOS ALAMOS NATIONAL LABORATORY CASE SELECTION

OCAS-PER-014 identified 49 Los Alamos National Laboratory (LANL) claims as potentially impacted by ORAUT-OTIB-0052. Of these claims, only one was sent back to NIOSH for revision, NIOSH Case #[redacted]. To date, this case has not been updated to incorporate CTW coworker dose. SC&A notes that this claim does not meet all of the criteria cited in OCAS-PER-014 to identify claims impacted by ORAUT-OTIB-0052, because no coworker dose was assigned. SC&A suspects that the case was not revised for this reason. This case does, however, represent an instance in which coworker dose was not assigned in the initial DR but should be assigned in a revised DR, as noted in SCA-TR-PR2012-0014, Finding #6.

**Finding 12: SC&A Questions whether NIOSH Is Planning on Revising the One Returned Case for CTW Coworker Dose at Los Alamos National Laboratory**

The LANL external coworker model was not issued until after the initial DR's completion; therefore, no coworker dose could be assigned in the initial DR. However, this EE meets all the criteria for CTW coworker dose to be assigned.

Because there were no LANL claims revised specifically due to ORAUT-OTIB-0052 and OCAS-PER-014, SC&A selected a case that had already been returned to NIOSH at the time of OCAS-PER-014 evaluations. Case #[redacted] was selected by SC&A for the review of an LANL case re-evaluated to incorporate the guidance of ORAUT-OTIB-0052.

## 6.2 BACKGROUND INFORMATION FOR CASE #[REDACTED]

Case #[redacted] represents an EE who worked at the LANL during the DOL-confirmed time from [redacted], through [redacted]. The dosimetry files also indicate the EE was monitored for external radiation in [redacted] and [redacted]. The EE's job functions during the employment period were [redacted], [redacted], [redacted]/ [redacted], and [redacted].

The EE was monitored for external photon and electron exposures during employment. Internal exposure monitoring was also conducted by means of in-vitro urinalysis bioassays. The EE was diagnosed with prostate cancer (ICD Code 185) on November 8, 2001. NIOSH assumed one continuous employment period extending from [redacted], through this date.

## 6.3 COMPARISON OF NIOSH'S ORIGINAL AND REWORKED DOSE RECONSTRUCTION

NIOSH performed the original DR of Case #[redacted]in June 2005. The claim was reworked in June 2008 to re-evaluate this case based on potential exposure to plutonium for Type Super S material. The revised DR also takes into account CTW coworker dose and the updated LANL TBDs. Both the original and revised DRs stated that the EE's radiation dose was overestimated using claimant-favorable assumptions. In the original DR, NIOSH calculated a dose of

62.79 rem to the prostate. Based on this assigned dose estimate, the DOL determined the POC to be 37.18% and the claim was denied.

Using the most current technical guidance documents and considering new CTW coworker dose guidance, NIOSH recalculated a dose of 61.386 rem to the prostate in the revised DR. Table 6-1 provides a comparison of the original and revised external and internal organ dose estimates for the prostate. It should be noted that the values cited in Table 6-1 were extracted directly from NIOSH's reworked DR. With the exception of external CTW coworker dose, SC&A has not assessed the accuracy or correctness of these doses, since performing such an assessment is beyond the scope of this Subtask 4 report.

**Table 6-1. Comparison of NIOSH-Derived External/Internal Dose Estimates Assigned for the Prostate in the Original and Reworked DRs for Case #[Redacted]**

| Dose Categories | Previous Dose (rem) | Revised Dose (rem) |
|---|---|---|
| External Measured and Missed | 36.931 | 50.308 |
| External Unmonitored | 1.650 | 2.847 |
| Ambient External | 7.918 | 0.000 |
| Medical X-ray | 0.038 | 0.048 |
| Internal | 16.192 | 8.183 |
| **Total** | **62.729** | **61.386** |

Using the EE's DOE records and claimant-favorable assumptions, a prostate dose of 61.386 rem resulted in a POC of 43.24%, and, on this basis, the revised claim was denied.

## 6.4 SC&A'S REVIEW OF OCAS-PER-014 ISSUES RELATED TO CASE #[REDACTED]

As directed by the Procedures Review Subcommittee, SC&A's review of Case #[redacted]strictly focused on external coworker models for CTWs. Case #[redacted] was included in the pool of claims that could potentially be impacted by ORAUT-OTIB-0052; however, the case was returned to NIOSH prior to the OCAS-PER-014 evaluation. This case met all of the OCAS-PER-014 criteria of (1) original DR was performed prior to August 31, 2006, (2) the EE worked as a CTW, (3) coworker dose was assigned, and (4) the POC was less than 50% but greater than 36.8%, except that the case was already being re-evaluated at the time OCAS-PER-014 was issued. This case was selected by SC&A for review because it represented a CTW who was not monitored for external exposure at LANL.

The EE was not monitored for external photon exposure during [redacted] and neutron exposure during [redacted], [redacted], [redacted], and [redacted]. Because no LANL coworker model was published at the time of the **original** DR, ORAUT-OTIB-0020, Rev. 00, and a compilation of completed coworker models were used to assign coworker dose. For the purposes of DR, NIOSH assigned the minimum doses at the 50$^{th}$ percentile based on a compilation of coworker studies. The DR does not indicate which models were used in this assessment, but does state that they come from a wide range of DOE sites and facilities. NIOSH assumed that the EE was exposed to 100% 30–250 keV photons and 100% 100 keV–2 MeV neutrons. NIOSH used the bladder as a surrogate for the prostate, which is not modeled by ICRP. The total dose for the unmonitored years was 0.137 rem from photons and 1.513 rem from neutrons.

In the **reworked** DR, NIOSH reviewed the dosimetry files and found that the EE was monitored less frequently than the original DR had assumed. Years with no or partial monitoring are listed in Table 6-2, along with the number of months that the EE was not monitored and for which coworker dose was assigned.

**Table 6-2. Summary of Coworker Dose for Case #[Redacted]**

| Year | # of Months Assigned |
|---|---|
| 1963 | 1 |
| 1964 | 7 |
| 1971 | 1 |
| 1974 | 2 |
| 1999 | 6 |
| 2000 | 12 |
| 2001 | 3 |

NIOSH adjusted the values from ORAUT-TKBS-0010-6, Table A-2, to account for the number of unmonitored months during each year. NIOSH assumed that the EE was exposed to 100% 30–250 keV photons and 100% 100keV–2MeV neutrons. No other adjustments were made to the Table A-2 values. This resulted in a coworker photon dose of 0.385 rem and a neutron dose of 2.462 rem.

SC&A does not concur with the coworker DR performed for NIOSH for Case #[redacted]. SC&A found the DR did not include any modification to coworker dose for CTWs.

**Finding 13: NIOSH Did Not Apply CTW Correction Factor to Coworker Dose**

Based on the EE's DOE files and the CATI report, it is unclear for which time periods the EE held each job title. SC&A found employment records located in the DOL initial case file indicating that the EE was hired as a [redacted] in [redacted] and as a [redacted] in [redacted]. Thus, the DOL files appear to indicate that the EE worked as a [redacted] from [redacted] to [redacted]. [Redacted] is a profession considered a construction trade by OCAS-PER-014. Therefore, using the guidance of ORAUT-OTIB-0052, a CTW adjustment factor of 1.4 should be applied to the measured component of coworker dose for CTW that was not monitored for external dose. Not doing so underestimates potential coworker dose during the EE's years as a [redacted] by a factor of 1.4, because LANL coworker dose does not have a missed dose component.

**Finding 14: NIOSH Did Not Apply Dose Conversion Factor or Dosimeter Correction Factors to Coworker Dose**

NIOSH did not correct any of the assigned coworker doses for the prostate DCF and did not account for dosimeter bias. Section 6 of ORAUT-OTIB-0020, Rev. 01, clearly states that both corrections should be applied to coworker dose to reasonably estimate dose to unmonitored workers. This would result in a yearly coworker photon dose ranging from 1.617 to 1.140 times larger than the dose assigned, and a yearly coworker neutron dose ranging from 2.865 to 2.063 times larger than the dose assigned.

**Observation #2**

OCAS-PER-014 makes the assumption that cases that are returned prior to PER evaluation will be updated to include the most recent technical guidance, including that of ORAUT-OTIB-0052. Case #[**redacted**] shows that the most recent guidance is not always incorporated into a DR. This raises the question: Were the remaining 83 cases that were returned to NIOSH prior to evaluation updated to include this guidance? Further investigation would be needed to determine if that was an isolated instance or a larger problem.

SC&A found that this rework was **not done** in accordance with guidance provided in ORAUT-OTIB-0052 and has two findings with NIOSH's methodology for assessing the EE's unmonitored CTW coworker dose.

# 7.0 REVIEW OF OCAS-PER-014 ISSUES FOR THE CASE FOR Y-12 PLANT

## 7.1 Y-12 PLANT CASE SELECTION

OCAS-PER-014 identified 159 ORNL Y-12 claims as potentially impacted by ORAUT-OTIB-0052. Of these claims, only 10 were sent back to NIOSH for revision. Each of these claims had one or more other employment sites also associated with it. From these claims, SC&A selected Case #[**redacted**] at random. Prior to evaluation, SC&A confirmed that this case was revised to include coworker dose.

## 7.2 BACKGROUND INFORMATION FOR CASE #[REDACTED]

Case #[**redacted**] represents an EE who worked at the Y-12 Plant during [**redacted**], through [**redacted**], and from [**redacted**], through [**redacted**]. This was combined into a single employment period by NIOSH. The EE's job functions during the employment period were [**redacted**]/ [**redacted**] and [**redacted**].

The EE was monitored for external photon and electron exposures during only some periods of employment. The EE was not monitored for internal exposure. The EE was diagnosed with adenocarcinoma of the prostate (ICD Code 185) on August 1, 1985.

## 7.3 COMPARISON OF NIOSH'S ORIGINAL AND REWORKED DOSE RECONSTRUCTION

NIOSH performed the original DR of Case #[**redacted**] in March 2006. The claim was reworked in January 2010 to evaluate the potential for additional dose based on new guidance for processing claims of CTWs. Both the original and revised DRs stated that the EE's radiation dose was overestimated using efficiency measures. In the original DR, NIOSH calculated a dose of 19.005 rem to the prostate. Based on this assigned dose estimate, the DOL determined the POC to be 21.59%, and the claim was denied.

Using the most current technical guidance documents and considering updated CTW coworker modeling, NIOSH recalculated a prostate dose of 20.876 rem in the revised DR. Table 7-1 provides a comparison of the original and revised external and internal organ dose estimates for the prostate. It should be noted that the values cited in Table 7-1 were extracted directly from NIOSH's reworked DR. With the exception of external coworker dose, SC&A has not assessed the accuracy or correctness of these doses, as such an assessment is beyond the scope of this report.

**Table 7-1. Comparison of NIOSH-Derived External/Internal Dose Estimates Assigned for the Prostate in the Original and Reworked DRs for Case #[Redacted]**

| Dose Categories | Previous Dose (rem) | Revised Dose (rem) |
|---|---|---|
| External Measured/Missed | 0.411 | 0.212 |
| External Coworker | 8.237 | 19.802 |
| Medical X-ray | 0.683 | 0.500 |
| Internal | 9.674 | 0.362 |
| **Total** | **19.005** | **20.876** |

Using the EE's DOE records and claimant-favorable assumptions, NIOSH calculated a prostate dose of 20.876 rem, resulting in a POC of 28.76%. On this basis, the revised claim was denied.

## 7.4 SC&A'S REVIEW OF OCAS-PER-014 ISSUES RELATED TO CASE #[REDACTED]

As directed by the Procedures Review Subcommittee, SC&A's review of Case #[redacted] strictly focused on external coworker models for CTWs. Case #[redacted] was included in the pool of claims that required the DR to be reworked because it met the OCAS-PER-014 criteria of (1) original DR was performed prior to August 31, 2006, (2) the EE worked as a CTW, (3) coworker dose was assigned, and (4) the POC was less than 50% but greater than 36.8%. This case was selected by SC&A because it represented a CTW claimant who was not monitored for radionuclide intakes at the Y-12 Plant.

This case is also impacted by the Y-12 Plant Special Exposure Cohort (SEC). Since the prostate is not a covered cancer, the EE does not qualify for automatic compensation under the SEC; under the SEC, no dose other than medical dose can be reconstructed for the years prior to 1948.

The EE was monitored for external dose only during the year [redacted]. In the **original** DR, NIOSH assigned coworker dose for the years [redacted]–[redacted] and [redacted]. A best-estimate organ dose was assigned by multiplying the 95$^{th}$ percentile of the lognormally distributed annual photon doses by the applicable triangular distribution of the organ DCF using Monte Carlo techniques in accordance with OCAS-IG-001. This resulted in the coworker dose of 8.237 rem.

In the **reworked** DR, NIOSH identified that the job title qualified this EE as a CTW. NIOSH assigned 50$^{th}$ percentile gamma CTW dose from ORAUT-OTIB-0064, Table 7-2, to the years [redacted]–[redacted] and [redacted]. NIOSH assumed that 100% of the gamma dose was 30–250 keV photons. No beta coworker dose was included because it would not contribute additional dose to the prostate. Since the prostate is not modeled by ICRP, NIOSH assumed the bladder to be a reasonable surrogate organ and applied the applicable organ DCF to the modeled CTW coworker dose. This resulted in a total CTW coworker dose of 19.802 rem.

NIOSH did not include a workbook in the EE's case file demonstrating how CTW coworker dose was calculated. SC&A was able to replicate the IREP-assigned dose by multiplying the ORAUT-OTIB-0064, Table 7-2, CTW coworker doses by the organ DCF for the prostate (bladder used as surrogate organ). SC&A requested that NIOSH provide the most recent workbook version; however, NIOSH was unable to provide a workbook during the course of this

review. SC&A obtained a copy of a recent workbook titled, "Y-12 Calculation Workbook 1.18," Version 1.18. This workbook did not have a tab for the calculation of coworker or CTW coworker dose.

**Finding 15: Dosimeter Uncertainty Not Applied to CTW Coworker Dose**

The Y-12 TBD (ORAUT-TKBS-0014-6) states that the standard error for recorded film badges prior to 1980 is 30%; as such, recorded photon results prior to 1980 at Y-12 are multiplied by a factor of 1.3 to account for this uncertainty. Coworker dose at Y-12 should be assumed to have the same standard error because it is based on measured dosimeter results. ORAUT-OTIB-0020, Rev. 02, Section 3.0, states that technical considerations, such as dosimeter bias, should be incorporated by the dose reconstructor into the coworker dose. This would increase the assigned CTW coworker dose by 30%.

SC&A was able to verify that NIOSH's assumptions were appropriate and claimant favorable. SC&A also verified the IREP input, which indicated that the doses were entered with the appropriate distribution and uncertainty parameters. SC&A found that the rework was done in accordance with guidance provided in ORAUT-OTIB-0052. SC&A did note, however, that NIOSH failed to apply the dosimeter uncertainty factor to the CTW dose, as recommended by ORAUT-OTIB-0020, Rev 3, and ORAUT-TKBS-0014-6.

# 8.0 REVIEW OF OCAS-PER-014 HANFORD ISSUES

## 8.1 HANFORD CASE SELECTION

OCAS-PER-014 identified 166 Hanford claims as potentially impacted by ORAUT-OTIB-0052. Of these claims, only 14 were sent back to NIOSH for revision. Of these 14 returned claims, only 3 were revised to include CTW coworker dose. SC&A selected a case at random from these three claims.

Case #[redacted] was selected by SC&A for the review of a Hanford case re-evaluated to incorporate the guidance of ORAUT-OTIB-0052. This case meets the OCAS-PER-014 criteria of (1) original DR was performed prior to August 31, 2006, (2) the EE worked as a CTW, (3) coworker dose was assigned, and (4) the POC was less than 50% but greater than 29.0% for a Hanford case.

## 8.2 BACKGROUND INFORMATION FOR CASE #[REDACTED]

Case #[redacted] represents an EE who worked at Hanford during [redacted], through [redacted], and also during [redacted], through [redacted]. The EE's job functions during the employment period were [redacted] and [redacted]. According to the CATI report and DOL records, the EE worked primarily in the 300 Area.

The EE was not monitored for internal or external exposure while employed at Hanford. The EE was diagnosed with carcinoma of the left breast (ICD Code 175) on June 23, 1989. The EE was also diagnosed with basal cell carcinoma (skin cancer) on the tip of the nose (ICD Code 173.3) on September 12, 1996.

## 8.3 COMPARISON OF NIOSH'S ORIGINAL AND REWORKED DOSE RECONSTRUCTION CASE #[REDACTED]

NIOSH performed the original DR of Case #[redacted] in June 2005. The claim was reworked in April 2010 to re-evaluate this case based on new guidance for CTW coworker modeling. The original DR was completed using maximizing assumptions, and the revised DR was completed with best-estimate assumptions. In the original DR, NIOSH calculated a dose of 9.564 rem to the breast and a dose of 8.605 rem to the skin of the nose. Based on this assigned dose estimate, the DOL determined the POC to be 42.36%, and the claim was denied.

Using the most current technical guidance documents and considering the new CTW coworker modeling recommendations, NIOSH recalculated a breast dose of 4.567 rem and a skin dose of 4.488 rem in the revised DR. Table 8-1 and Table 8-2 provide a comparison the original and revised external and internal organ dose estimates for the breast and skin. It should be noted that the values cited in Table 8-1 and Table 8-2 were extracted directly from NIOSH's reworked DR. With the exception of internal and external CTW coworker modeling, SC&A has not assessed the accuracy or correctness of these doses, since performing such an assessment is beyond the scope of this Subtask 4 report.

**Table 8-1. Comparison of NIOSH-Derived External/Internal Dose Estimates Assigned for the Breast in the Original and Reworked DRs for Case #[Redacted]**

| Dose Categories | Previous Dose (rem) | Revised Dose (rem) |
|---|---|---|
| External Coworker | 2.718 | 2.586 |
| Ambient External | 0.210 | 0.90 |
| Medical X-ray | 0.012 | 0.150 |
| Internal | 6.625 | 1.742 |
| **Total** | **9.564** | **4.567** |

**Table 8-2. Comparison of NIOSH-Derived External/Internal Dose Estimates Assigned for the Skin of the Nose in the Original and Reworked DRs for Case #[Redacted]**

| Dose Categories | Previous Dose (rem) | Revised Dose (rem) |
|---|---|---|
| External Coworker | 2.718 | 2.279 |
| Ambient External | 0.210 | 0.144 |
| Medical X-ray | 0.008 | 0.098 |
| Internal | 5.670 | 1.968 |
| **Total** | **8.605** | **4.488** |

Using the EE's DOE records and claimant-favorable assumptions, a breast dose of 4.567 rem and a skin dose of 4.488 rem resulted in a POC of 44.74%, and, on this basis, the revised claim was denied.

## 8.4 SC&A'S REVIEW OF OCAS-PER-014 ISSUES RELATED TO CASE #[REDACTED]

As directed by the Procedures Review Subcommittee, SC&A's review of Case #[redacted] strictly focused on external and internal coworker models for CTWs. Case #[redacted] was included in the pool of claims that required the DR to be reworked because it met the OCAS-PER-014 criteria of (1) original DR was performed prior to August 31, 2006, (2) the EE worked as a CTW, (3) coworker dose was assigned, and (4) the POC was less than 50% but greater than 29.0% for a Hanford case. This case was selected by SC&A because it represented an individual who was not monitored for radionuclide intake or external exposure at Hanford.

### 8.4.1 External Coworker Dose

Even though the EE was not monitored for external exposure, the **original** DR made the claimant-favorable assumption that the EE was likely exposed to external radiation during employment. Using the Hanford External Coworker model, NIOSH assigned 95$^{th}$ percentile deep/gamma dose to reconstruct the external dose experienced by the EE in [redacted]. No coworker dose was assigned to the EE during the 1-month employment during January 1943, because major radiological work did not begin in the 300 Area until [redacted]. NIOSH did not consider potential coworker neutron exposures, because it was thought that neutrons would contribute an insignificant amount to dose in comparison to other claimant-favorable assumptions. NIOSH assigned an external coworker total dose of 2.718 rem to the breast and 2.718 rem to the skin.

After the initial DR, this case was impacted by the Hanford SEC. Since the EE did not work at least 250 days at the site, the EE does not qualify for automatic compensation under the SEC. Therefore, only a partial DR could be completed for the EE in the **reworked** DR. In the reworked DR, NIOSH identified that the EE's two job descriptions were both construction trade jobs. NIOSH assigned the 50th percentile CTW coworker photon and electron doses from ORAUT-TKBS-0006-6, Table B-3, adjusted to account for organ and energy distributions in the 300 Area. External coworker gamma and electron doses were prorated to account for the 9 months of employment in [**redacted**]. NIOSH also prorated neutron dose to 7 months, because 300 Area neutron work did not begin until [**redacted**]. Using these adjustments, NIOSH assigned external CTW coworker dose as summarized in Table 8-3.

**Table 8-3. Summary of External CTW Coworker Dose for Case #[Redacted]**

| Cancer Location | Diagnosis Date | Coworker Gamma dose (rem) | Coworker Electron dose (rem) | Coworker Neutron dose (rem) |
|---|---|---|---|---|
| Breast | 6/23/1989 | 0.920 | 0.054 | 1.612 |
| Skin | 9/12/1996 | 0.970 | 0.153 | 1.156 |

OCAS-PER-014 noted that external Hanford coworker dose guidance was documented in ORAUT-OTIB-0030. This document was canceled and the external coworker dose guidance was incorporated into Attachment B of ORAUT-TKBS-0006-6, Rev. 4, issued on January 7, 2010. As part of this Subtask 4 report, SC&A reviewed the Hanford guidance, ORAUT-TKBS-0006-6, Rev. 4, and found that missed and measured doses are reported as a single value for each percentile of coworker dose in Table B-2. ORAUT-TKBS-0006-6, Rev. 4, added an additional table (Table B-3) that includes coworker doses for CTWs.

SC&A requested that NIOSH provide separate values for missed and measure coworker dose from Table B-2, so that SC&A could independently confirm that the guidance from ORAUT-OTIB-0052 was properly implemented and recorded in Table B-3. NIOSH was unable to provide these values to SC&A during the course of SC&A's review of OCAS-PER-014.

Because these separate missed and measured coworker dose data were unavailable, SC&A preformed a cursory check of the values assuming NIOSH properly implemented the 1.4 adjustment to the 99th, 95th, and 50th percentiles. SC&A found the following to be true for each year and percentile:

(CTW dose – Coworker dose)/0.4 = Measured dose
Coworker dose – Measured dose = Missed dose
Measured dose *1.4 + Missed dose = CTW dose

**Finding 16: SC&A Could Not Conclusively Confirm the CTW Adjustment Factor Was Properly Applied to Measured Dose at Hanford**

Although our above-cited cursory check of the application of the 1.4 adjustment factor is consistent with the values presented in the coworker and CTW coworker models in Tables B-2 and B-3, it cannot be used to prove conclusively that the adjustment was properly made at the site, because there are many possible combinations of adjustment factors to missed and measured

dose that could yield the final adjusted values for CTW coworker dose. Source data are needed to conclusively show the adjustment was correctly applied.

SC&A reviewed the EE files and found that NIOSH used the workbook titled "HAN B.E. Calc Wkbk (Vose) 3.11" to calculate CTW coworker dose to the EE. As part of this review, SC&A verified that the workbook was properly updated to incorporate the guidance from ORAUT-OTIB-0052. Coworker doses from the 99$^{th}$, 95$^{th}$, and 50$^{th}$ percentile CTW coworker photon dose were updated to include the guidance from ORAUT-OTIB-0052. The external coworker data and CTW coworker data contained in the workbook match the values listed in ORAUT-TKBS-0006-6, Rev. 4, Tables B-2 and B-3. NIOSH correctly manually manipulated the [**redacted**] data to prorate dose for a partial year of employment.

Although it appears that the rework of the external components of CTW coworker dose was done in accordance with guidance provided in ORAUT-OTIB-0052, SC&A can only conclusive verify that the 1.4 adjustment factor was accurately applied to CTW doses if we have a breakdown of missed versus measured external dose.

### 8.4.2 Internal Coworker Dose

The **original** DR also made the claimant-favorable assumption that the EE was likely exposed to internal radiation during the second employment period. No internal dose was assigned to the 1 month the EE worked during [**redacted**], because radiological work in the 300 Area of Hanford had not yet started. During the [**redacted**] employment period, NIOSH assumed that the EE was likely exposed to each radionuclide likely to result in significant internal dose. NIOSH, however, does not identify these radionuclides. NIOSH used ORAUT-OTIB-0002, Rev. 01 PC-2, guidance to maximize internal dose estimates to the skin and breast. This resulted in a total skin dose of 5.670 rem and a breast dose of 6.625 rem.

In the **reworked** DR, NIOSH found that the EE was at risk for internal exposure to radioactive materials from the EE's employment during 1944, even though there is no record that the EE was monitored at this time. During this year, only the 313, 314, and 303 fuel fabrication facilities and the 321 and 3741 research and development facilities were operational in the 300 Area. Based on this assumption and the duties of a [**redacted**] and [**redacted**], NIOSH found the largest exposure risk to the EE was U-234. No plutonium or fission product dose could be assigned, due to the Hanford SEC. The site profile indicates unmonitored workers in the 300 Area fuel fabrication area should be assigned "in accordance with the Process/Job Title of Machining/Operator, as presented in Battelle-TBD-6000." Based on this, NIOSH assigned a uranium Type M intake rate of 19,654 pCi/d. This resulted in a dose of 1.742 rem to the breast and 1.968 rem to the skin of the nose.

SC&A reviewed the Hanford internal dose documents and found that use of insoluble uranium is recommended in the ORAUT-TKBS-0006-5, Rev. 5, for unmonitored workers that worked in the 300 Area. SC&A confirmed that the intake rate assigned (19,654 pCi/d) matches the Machining/Operator recommendations of TBD-6000. This intake rate was not modified in any way. NIOSH modeled U-234 intake in IMBA assuming both Type M and Type S uranium. SC&A confirmed that Type M results in the highest dose to both organs modeled.

SC&A notes that the document that contained internal Hanford Coworker guidance, ORAUT-OTIB-0039, was canceled. Hanford internal coworker dose guidance was incorporated into Attachment C of ORAUT-TKBS-0006-5, Rev. 3, which was issued on January 7, 2010. The current version of this document, Rev. 5, was issued on November 5, 2012. SC&A found no mention of ORAUT-OTIB-0052 or its guidance in this document. For the benefit of the reader, ORAUT-OTIB-0052, Section 8.4, states:

> *For Hanford dose reconstructions covered by this TIB, the intake rates in the Hanford coworker document should be multiplied by a factor of 2.*

No other sites require an internal CTW coworker modification.

**Finding 17: No CTW Correction Was Applied to the Unmonitored CTW Internal Dose**

NIOSH did not take into account the recommendations of ORAUT-OTIB-0052 when the DR was revised. Unmonitored internal dose was assigned without any modification of intake rates to account for the EE being a CTW. SC&A notes that the intake assigned is large compared to coworker doses from later years that were not based on Battelle-TBD-6000 values. NIOSH neither followed the guidance of ORAUT-OTIB-0052 nor discussed its omission in the DR report.

**Finding 18: There Do Not Appear to Be Any Hanford-Specific Technical Guidance Documents Requiring the Implementation of ORAUT-OTIB-0052 for Internal Coworker Dose for CTWs**

ORAUT-OTIB-0052 directs dose reconstructors to multiply unmonitored coworker intake rates by 2 for CTWs who worked at Hanford. SC&A found that this guidance is not reflected in the Hanford Internal Dose TBD. Dose reconstructors can make the appropriate adjustments to Hanford internal coworker dose without a revision to the document; however, in order to properly assign coworker internal dose at Hanford, the dose reconstructor must be familiar with ORAUT-OTIB-0052 and its implications on internal CTW coworker dose at Hanford.

Along with reviewing the ORAUT-OTIB-0052 guidance, SC&A analyzed the IMBA input and applicable workbooks for Case #[**redacted**] and found that the data were entered correctly. SC&A also verified the IREP input, which indicated that the doses were entered with the appropriate distribution and uncertainty parameters. However, SC&A found no evidence that NIOSH made any CTW adjustment to the internal dose, as required under ORAUT-OTIB-0052. In addition, we question the absence of any Hanford-specific guidance for internal dose to CTWs, as cited in ORAUT-OTIB-0052.

# 9.0 REVIEW OF OCAS-PER-014 ISSUES FOR THE KANSAS CITY PLANT

## 9.1 KANSAS CITY PLANT CASE SELECTION

OCAS-PER-014 identified 56 KCP claims as potentially impacted by ORAUT-OTIB-0052. Of these claims, only five were sent back to NIOSH for revision. Of these five claims, none were revised to include CTW coworker dose, because they did not meet the minimum POC criterion. SC&A questions why these cases were returned to NIOSH if they did not meet the review threshold.

SC&A was unable to find a KCP case that was revised to incorporate CTW coworker recommendations. There were no cases "returned prior to evaluation," and only one case was sent back to NIOSH for another PER. However, it was not revised in accordance with ORAUT-OTIB-0052, because the EE did not qualify as a CTW.

## 9.2 KANSAS CITY PLANT DOCUMENTATION EVALUATION

Since no KCP cases were revised to incorporate CTW coworker dose, SC&A was unable to evaluate a case impacted by ORAUT-OTIB-0052 guidance. In order to assess the likelihood that future cases are evaluated correctly, SC&A reviewed the KCP site profile, ORAUT-TKBS-0031, and applicable workbooks.

SC&A found that ORAUT-TKBS-0031 has not been revised since the issue of OCAS-PER-014. Recorded coworker doses are listed in Table 15 of ORAUT-TKBS-0031, Rev. 00 PC-1. Unlike most other sites, coworker doses in Table 15 of ORAUT-TKBS-0031 do not include missed dose. However, there is no guidance to dose reconstructors to adjust this dose by a factor of 1.4 for CTWs.

SC&A requested that NIOSH provide the most recent KCP workbook for review. NIOSH was unable to provide this workbook during the course of SC&A's review of OCAS-PER-014. SC&A independently located a recent version of the KCP workbook titled, "KCP Calculation workbook," Version 1.13. This version of the workbook did not have a tab for coworker dose or any modifications for coworker dose at KCP.

**Finding 19: There Do Not Appear to Be Any KCP Guidance Documents or Workbook for Implementing CTW Dose Adjustment Cited in ORAUT-OTIB-0052**

ORAUT-TKBS-0031 has not been modified, there has not been a separate KCP-specific TIB issued to provide guidance included in ORAUT-OTIB-0052 for CTW dose adjustments, In addition, SC&A was unable to confirm whether an updated version of the KCP workbook has been issued that contains coworker data.

# 10.0 REVIEW OF OCAS-PER-014 ISSUES FOR PANTEX PLANT

## 10.1 PANTEX PLANT CASE SELECTION

OCAS-PER-014 identified one Pantex Plant claim as potentially impacted by ORAUT-OTIB-0052, Claim #[redacted]. This claim was returned to NIOSH following the release of OCAS-PER-012, rather than OCAS-PER-014. The claim, however, was not revised. It is unclear to SC&A why the claim was not revised, because the OCAS-PER-012 letter indicates that the case must be revised "to determine the extent to which th[e] claim is affected."

## 10.2 PANTEX PLANT DOCUMENTATION EVALUATION

Because no Pantex cases were revised to incorporate CTW coworker dose, SC&A was unable to evaluate a case impacted by ORAUT-OTIB-0052 guidance. In order to assess the likelihood that future cases are evaluated correctly, SC&A looked at the 2006 Pantex Plant Occupational External Dose TBD (ORAUT-TKBS-0013-6, Rev. 00). SC&A found that this document was revised on June 22, 2007 (Rev. 01). This revision occurred after the issue of ORAUT-OTIB-0052 but before the issuance of OCAS-PER-014. The revised Occupational External Dose TBD makes no reference to the guidance in ORAUT-OTIB-0052.

SC&A found that, although ORAUT-TKBS-0013-6 has been revised since the issue of ORAUT-OTIB-0052, it was not revised to include guidance from ORAUT-OTIB-0052. Recorded coworker doses are listed in Table 6-17 of ORAUT-TKBS-0013-6, Rev. 01. Unlike for most other sites, coworker doses in Table 6-17 of ORAUT-TKBS-0013-6 do not include missed dose. However, there is no guidance to dose reconstructors to adjust this dose by a factor of 1.4 for CTWs.

SC&A requested that NIOSH provide the most recent Pantex workbook for review. NIOSH was unable to provide this workbook during the course of SC&A's review of OCAS-PER-014. SC&A attempted to independently locate a workbook as part of this Task 4 Review for Pantex but was unsuccessful.

**Finding 20: There Do Not Appear to Be Any Pantex-Specific Guidance Documents or Workbook for Implementing CTW Dose Adjustment Cited in ORAUT-OTIB-0052**

As indicated above, ORAUT-TKBS-0013-6 has been revised since the issuance of ORAUT-OTIB-0052; however, no change was made to implement CTW dose adjustment guidance. In addition, SC&A verified that there been not been a separate Pantex-specific TIB issued to provide guidance included in ORAUT-OTIB-0052. Lastly, SC&A was unable to confirm whether an updated version of the Pantex workbook has been issued that contains coworker data.

# 11.0 REVIEW OF OCAS-PER-014 ISSUES FOR PACIFIC NORTHWEST NATIONAL LABORATORY

## 11.1 PACIFIC NORTHWEST NATIONAL LABORATORY CASE SELECTION

OCAS-PER-014 identified 18 Pacific Northwest National Laboratory (PNNL) claims as potentially impacted by ORAUT-OTIB-0052. None of these cases were sent back to NIOSH for revision. Of the 18 potentially impacted claims, 8 were returned to NIOSH for another PER, and 3 claims were returned prior to evaluation. None of these claims were revised to include CTW coworker dose from PNNL.

## 11.2 PACIFIC NORTHWEST NATIONAL LABORATORY DOCUMENTATION EVALUATION

Since no PNNL cases were revised to incorporate CTW coworker dose, SC&A was unable to evaluate a case impacted by ORAUT-OTIB-0052 guidance. Coworker dose at PNNL is assigned using the same guidance as Hanford. Since SC&A previously reviewed this guidance in Section 8, no new evaluation was warranted for PNNL CTW coworker dose.

# 12.0 REVIEW OF OCAS-PER-014 ISSUES FOR WELDON SPRINGS PLANT

## 12.1 WELDON SPRINGS PLANT CASE SELECTION

OCAS-PER-014 identified 19 Weldon Spring Plant claims as potentially impacted by ORAUT-OTIB-0052. Only one of these claims was sent back to NIOSH for revision, Case #[redacted]. Notably, this case does not have an OCAS-PER-014 evaluation letter included in the file. The EE in this case does not qualify as a CTW; therefore, no CTW coworker dose was assigned. SC&A located one Weldon Spring case (#[redacted]) that was labeled as "return to NIOSH" NIOSH as a result of OCAS-PER-015; however, this case was also not re-evaluated. This is another instance of a case that was returned and not revised, as discussed in Finding 2.

## 12.2 WELDON SPRINGS PLANT DOCUMENTATION EVALUATION

Because no Weldon Spring Plant cases were revised to incorporate CTW coworker dose, SC&A was unable to evaluate a case impacted by ORAUT-OTIB-0052 guidance. In order to assess the likelihood that future cases are evaluated correctly, SC&A reviewed the Weldon Spring Plant Occupational External Dose TBD (ORAUT-TKBS-0028-6, Rev. 00) and applicable workbooks. SC&A found that this document was issued on June 24, 2005.

SC&A found that the latest revision of ORAUT-TKBS-0028-6 (Rev. 01) was on February 6, 2013. Recorded coworker doses are listed in Table 6-8 of this revised TBD. Unlike for most other sites, coworker dose in Table 6-8 of ORAUT-TKBS-0028-6 does not include missed dose. There is no guidance to dose reconstructors to adjust this dose by a factor of 1.4 for CTWs. In order for CTW coworker dose to be properly assigned, a dose reconstructor must be familiar with ORAUT-OTIB-0052.

SC&A requested that NIOSH provide the most recent Weldon Spring workbook for review. NIOSH was unable to provide this workbook during the course of SC&A's review of OCAS-PER-014. Based on SC&A's evaluation of the DR Tools folder on the O-drive, we have concluded that there has been no workbook developed specific to Weldon Spring Plant.

**Finding 21: There Do Not Appear to Be Any Weldon Spring Plant Guidance Documents or Workbook for Implementing CTW Dose Adjustment Cited in ORAUT-OTIB-0052**

ORAUT-TKBS-0028-6 has not been modified, and there has not been a separate Weldon Spring-specific TIB issued to provide guidance included in ORAUT-OTIB-0052 for CTW dose adjustments. In addition, SC&A does not believe a Weldon Spring-specific workbook has been developed.

# 13.0 SUMMARY CONCLUSIONS

Under SC&A's *A Protocol to Review NIOSH's Program Evaluation Reports (PERs)* (SCA-TR-PR2009-0002), Subtask 4 requires the audit of DR cases reworked as a result of the PER under review. Based on guidance in OCAS-PER-014, cases required rework if they met the following criteria: (1) original DR was performed prior to August 31, 2006, (2) the EE worked as a CTW, (3) coworker dose was assigned, and (4) the POC was less than 50% but greater than 36.8% (29% for Hanford). Therefore, in order to satisfy Subtask 4, SC&A recommended in SCA-TR-PR2012-0014 the selection of 1 case from each of 10 impacted sites addressed in OCAS-PER-014.

For each of the six reviewed cases, SC&A provided an overview of the case and a brief comparison of external and internal doses assigned in the original and revised DRs. Based on directives from the Procedures Review Subcommittee, SC&A's audit of these cases focused strictly on those elements of the DR that were affected by the issuance of ORAUT-OTIB-0052 and OCAS-PER-014. This included the review of a case from each site affected by ORAUT-OTIB-0052 and evaluation of each site's TBD and applicable workbooks to ensure they were properly undated to incorporate ORAUT-OTIB-0052's CTW coworker recommendations. Cases were selected at random from SRS, X-10, Y-12, PGDP, and Hanford from the 52 cases returned to NIOSH for re-evaluation. Each case's CTW coworker DR was reviewed. Additionally, SC&A evaluated each site's technical guidance on CTW and workbooks to ensure they were consistent with the recommendations of ORAUT-OTIB-0052.

Although every site had at least one case impacted by the PER, SC&A found that several sites (i.e., LANL, PNNL, KCP, Weldon Spring Plant, and Pantex Plant) did not have any cases revised as a result of being sent back to NIOSH. Because it was acknowledged that not all of the 10 sites would likely have a case that was returned specifically for OCAS-PER-014, during the July 31, 2012, meeting, the Procedures Review Subcommittee agreed to allow SC&A to select cases that were returned to NIOSH for other reasons (e.g., another PER) and for which the rework included ORAUT-OTIB-0052 guidance.

If no case could be found that was impacted by ORAUT-OTIB-0052 for a particular site, SC&A was tasked with verifying that the applicable guidance and workbooks were properly updated. SC&A was unable to identify any cases that required rework due to ORAUT-OTIB-0052 (or were revised to include guidance) for the KCP, Pantex Plant, PNNL, and Weldon Spring Plant. As a result, SC&A reviewed the CTW coworker guidance in each site's applicable documentation (excluding PNNL, as discussed in Section 11.2) to verify that this guidance was properly updated to reflect the guidance in ORAUT-OTIB-0052.

During the course of this review, SC&A noted that of the six cases evaluated, the assigned coworker dose for three cases decreased from the original DR to the revised DR. This was due to the fact that, in the original DR, NIOSH elected to use the 95$^{th}$ percentile coworker model, and in the revised case, NIOSH switched to the 50$^{th}$ percentile model. In fact, NIOSH revised the selected coworker models from 95$^{th}$ percentile in the original DR to 50$^{th}$ percentile in the reworked DR in five of the six cases that were evaluated by SC&A. The 6$^{th}$ case reviewed by SC&A used the 50$^{th}$ percentile distribution in both the original and revised DRs. Although

ORAUT-OTIB-0020 is outside of the scope of this Subtask 4 review, its interpretation has a direct impact on the implementation of ORAUT-OTIB-0052. This resulted in Finding 22, which is discussed below.

**Finding 22: Ambiguity in ORAUT-OTIB-0020 Impacts the Application of ORAUT-OTIB-0052**

SC&A found that there is ambiguity associated with guidance provided in ORAUT-OTIB-0020, Rev. 03, for assigning 95$^{th}$ versus 50$^{th}$ percentile doses for the various CTW job categories. The following is cited in ORAUT-OTIB-0020, Rev. 03, page 6:

> *In general, the 50th-percentile dose may be used as a best estimate of a worker's dose when professional judgment indicates the worker was likely exposed to intermittent low levels of external radiation. The 50th-percentile dose should not be used for workers who were routinely exposed. For routinely exposed workers (i.e., workers who were expected to have been monitored), the 95th-percentile dose should be applied. Also note that certain construction trades (e.g., pipefitters) might have received higher exposures than construction trade workers in general; therefore, they might fall into the category of workers who were expected to have been monitored.*

Clarity on which trades should be assigned 95$^{th}$ percentile would be beneficial to the DR process, especially since this selection will have a significant impact on the assigned dose. Additionally, some CTW coworker models (i.e., Hanford and SRS) also have 99$^{th}$ percentile doses. Using the currently available guidance, it appears the 99$^{th}$ percentile values would never be selected for use in a DR.

SC&A's Subtask 1–3 review resulted in 6 findings, which are contained in SCA-TR-PR2012-0014. SC&A's Subtask 4 review resulted in the identification of 16 findings. These findings are summarized below.

- Finding 7: Application of Selection Criteria in Question
- Finding 8: Not All Cases "Returned to NIOSH" Were Re-evaluated
- Finding 9: SC&A Could Not Conclusively Confirm the CTW Adjustment Factor Was Properly Applied to Measured Dose at Savannah River Site
- Finding 10: SC&A Could Not Conclusively Confirm the CTW Adjustment Factor Was Properly Applied to Measured Dose at X-10, Y-12, and K-25
- Finding 11: SC&A Could Not Conclusively Confirm the CTW Adjustment Factor Was Properly Applied to Measured Dose at Portsmouth
- Finding 12: SC&A Questions whether NIOSH Is Planning on Revising the One Returned Case for CTW Coworker Dose at Los Alamos National Laboratory

- Finding 13: NIOSH Did Not Apply CTW Correction Factor to Coworker Dose
- Finding 14: NIOSH Did Not Apply Dose Conversion Factor or Dosimeter Correction Factors to Coworker Dose
- Finding 15: Dosimeter Uncertainty Not Applied to CTW Coworker Dose
- Finding 16: SC&A Could Not Conclusively Confirm the CTW Adjustment Factor Was Properly Applied to Measured Dose at Hanford
- Finding 17: No CTW Correction was Applied to the Unmonitored CTW Internal Dose
- Finding 18: There Do Not Appear to Be Any Hanford-Specific Technical Guidance Documents Requiring the Implementation of ORAUT-OTIB-0052 for Internal Coworker Dose for CTWs
- Finding 19: There Do Not Appear to Be Any KCP Guidance Documents or Workbook for Implementing CTW Dose Adjustment Cited in ORAUT-OTIB-0052
- Finding 20: There Do Not Appear to Be Any Pantex-Specific Guidance Documents or Workbook for Implementing CTW Dose Adjustment Cited in ORAUT-OTIB-0052
- Finding 21: There Do Not Appear to Be Any Weldon Spring Plant Guidance Documents or Workbook for Implementing CTW Dose Adjustment Cited in ORAUT-OTIB-0052
- Finding 22: Ambiguity in ORAUT-OTIB-0020 Impacts the Application of ORAUT-OTIB-0052

In Sections 2 through 12 above, SC&A also made two observations. In the first observation, SC&A points out that applying a photon dosimetry CF of 1.165 to the entire CTW coworker dose, which is a combination of missed and measured dose, results in an overestimate of dose at PGDP.

The second observation questions whether all of the 83 cases that were returned to NIOSH prior to the PER evaluation, but after the issuance of ORAUT-OTIB-0052, were updated to include the most recent technical guidance.

# 14.0 REFERENCES

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