
DRAFT

ADVISORY BOARD ON RADIATION AND WORKER HEALTH

**NATIONAL INSTITUTE FOR
OCCUPATIONAL SAFETY AND HEALTH**

**A REVIEW OF NIOSH'S PROGRAM EVALUATION REPORT
OCAS-PER-011: K-25 TBD AND TIB REVISIONS**

**Contract No. 200-2009-28555
SCA-TR-PR2013-0080, Rev. 0**

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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-PR2013-0080
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A Review of NIOSH’s Program Evaluation Report OCAS-PER-011: K-25 TBD and TIB Revisions	Page 2 of 34
Task Manager/Reviewer: _____ Date: _____ U. Hans Behling, PhD, MPH	Supersedes: N/A
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Record of Revisions

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ABBREVIATIONS AND ACRONYMS

CF	Correction Factor
CTW	Construction Trades Worker
DOL	(U.S.) Department of Labor
DR	Dose Reconstruction
EE	Energy Employee
ICE	Individual Case Evaluation
NIOSH	National Institute for Occupational Safety and Health
NOCTS	NIOSH OCAS Claims Tracking System
OCAS	Office of Compensation Analysis and Support
ORAUT	Oak Ridge Associated Universities Team
PEP	Program Evaluation Plan
PER	Program Evaluation Report
POC	Probability of Causation
SC&A	S. Cohen and Associates
TBD	Technical Basis Document
TIB	Technical Information Bulletin

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1.0 STATEMENT OF PURPOSE

To support dose reconstruction (DR), the National Institute for Occupational Safety and Health (NIOSH) and the Oak Ridge Associated Universities Team (ORAUT) assembled a large body of guidance documents, workbooks, computer codes, and tools. In recognition of the fact that all of these supporting elements in DR may be subject to revisions, provisions exist for evaluating the effect of such programmatic revisions on the outcome of previously completed DRs. Such revisions may be prompted by document revisions due to new information, misinterpretation of guidance, changes in policy, and/or programmatic improvements.

The process for evaluating potential impacts of programmatic changes on previously completed DRs has been proceduralized in Revision 2 of OCAS-PR-008, *Preparation of Program Evaluation Reports and Program Evaluation Plans*, dated December 6, 2006. This procedure describes the format and methodology to be employed in preparing a Program Evaluation Report (PER) and a Program Evaluation Plan (PEP).

A PER provides a critical evaluation of the effect(s) that a given issue/programmatic change may have on previously completed DRs. This includes a qualitative and quantitative assessment of potential impacts. Most important in this assessment are the potential impacts on the Probability of Causation (POC) of previously completed DRs with POCs <50%.

A PEP may be issued as a formal notification of an impending PER. The PEP provides a preliminary description of the issue(s) that will be addressed in the PER, and summarizes the likely scope of the effort required to complete the PER.

During an Advisory Board Subcommittee on Procedures Review meeting on July 21, 2012, SC&A was tasked by the Advisory Board to conduct a review of OCAS-PER-011, *K-25 TBD and TIB Revisions*. In conducting a PER review, SC&A is committed to perform the following five subtasks, each of which is discussed in this report:

Subtask 1: Assess NIOSH's evaluation/characterization of the "issue" and its potential impacts on 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

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where the universe of DRs is too large and, for reasons of practicality, NIOSH's re-evaluation is confined to a subset of DRs. 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. 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.

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2.0 SUBTASK 1: IDENTIFY THE CIRCUMSTANCES THAT NECESSITATED OCAS-PER-011

OCAS-PER-011 was issued on November 26, 2007, in response to a series of technical revisions to the Technical Basis Document (TBD) for the *K-25 Site – Occupational External Dose* (ORAUT-TKBS-0009-6) and two ORAUT TIBs that affected this TBD. While some changes incorporated in these revisions increased the assigned doses, others resulted in a decrease. A chronological summary of document modifications that impacted external dose estimates is provided below:

- November 24, 2004, the external dose section (ORAUT-TKBS-0009-6) of the Oak Ridge Gaseous Diffusion Plant (K-25) was issued. This TBD documented an external dose coworker model for unmonitored workers at K-25. Prior to the issuance of ORAUT-TKBS-0009-6 Rev. 0, there was no external coworker model for K-25.
- May 31, 2005, ORAUT-OTIB-0026, *External Coworker Dosimetry Data for the K-25 Site*, was issued. This TIB replaced the coworker guidance contained in ORAUT-TKBS-0009-6. The revised coworker model changed the external coworker values **to account for missed dose**. This resulted in an increased coworker dose during some years.
- July, 29, 2005, ORAUT-OTIB-0026 Rev. 00 PC-1 was issued. The revision **reduced most of the missed doses** included in the previous revision.
- November 15, 2006, ORAUT-OTIB-0026 Rev. 00 PC-2 was issued. This revision incorporated guidance contained in ORAUT-OTIB-0052, *Parameters to Consider When Processing Claims from Construction Trade Workers* (Rev. 00 issued August 31, 2006) and added Section 8.0 and Table 3 for processing claims of construction trades workers (CTWs).

Other K-25 guidance documents have been revised; however, these revisions do not have an impact on the DR methodology.

2.1 SC&A'S COMMENTS ON NON-CONSTRUCTION TRADES WORKER GUIDANCE CHANGES

SC&A found the PER-011 description of the circumstances surrounding the issuance of the PER, which was contained in a single paragraph, to be exceedingly vague. To ascertain the full impact of the revised guidance, SC&A compared the historical K-25 coworker models against the most current non-CTW coworker guidance (ORAUT-OTIB-0026 Rev. 00 PC-2). Figures 2-1 and 2-2 illustrate a direct yearly comparison of the four penetrating dose models.

A direct comparison shows that, in general, the ORAUT-OTIB-0026 Rev. 00 and Rev. 00 PC-1 95th and 50th percentile coworker models for penetrating dose match or overestimate coworker dose in the Rev. 00 PC-2 model. In contrast, the coworker guidance in ORAUT-TKBS-0009-6 Rev. 00 consistently underestimated (pre-1975) dose compared to coworker guidance in ORAUT-OTIB-0026 Rev. 00 PC-2.

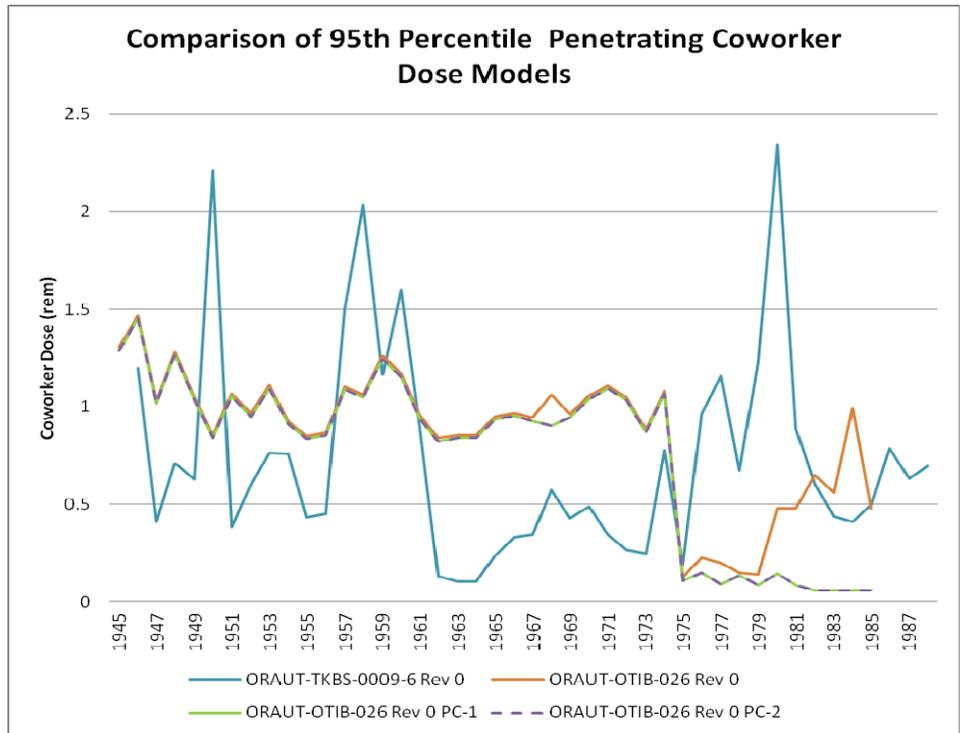


Figure 2-1. 95th Percentile Penetrating Coworker Dose Comparison

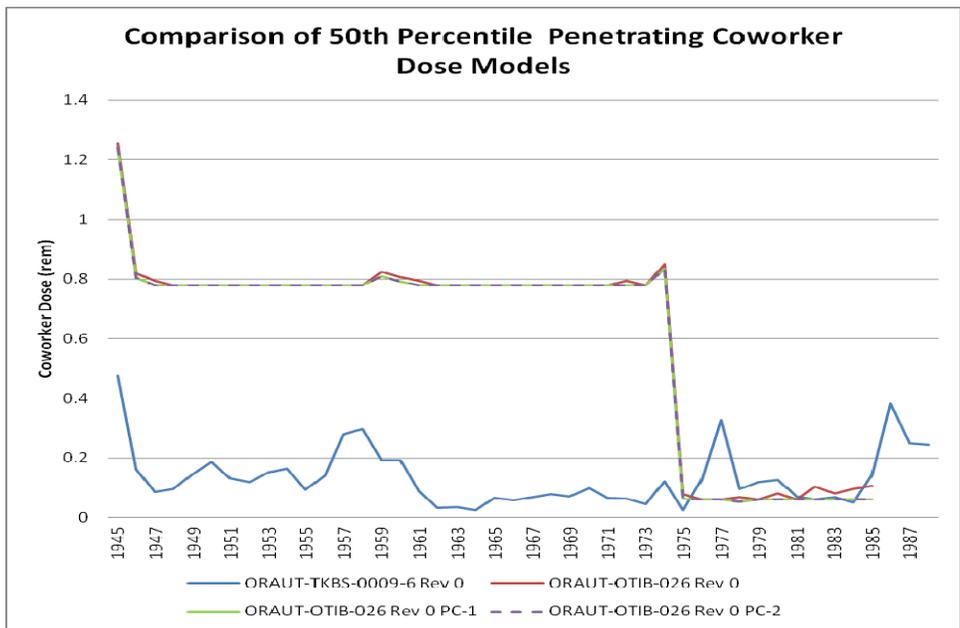


Figure 2-2. 50th Percentile Penetrating Coworker Dose Comparison

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Because the assignment of coworker dose is dependent on the length of employment, time of employment, cancer location, and job description, SC&A also analyzed the annual percent change between historical and current coworker guidance documents. The yearly 95th and 50th percentile coworker model values for each revision and a percent change comparison to the current K-25 coworker guidance document, ORAUT-OTIB-0026 Rev. 00 PC-2, is included as Appendices A through C of this report. For the convenience of the reader, a summary of these comparisons is provided in Table 2-1. **Red** and **green** texts are used for added emphasis to negative and positive percent changes, respectively.

Table 2-1. Summary of Yearly Percent Change Comparison to Current Non-CTW Coworker Guidance for Penetrating Dose

Percentile	ORAUT-TKBS-0009-6 Rev. 00		ORAUT-OTIB-0026 Rev. 00		ORAUT-OTIB-0026 Rev. 00 PC-1	
	95 th	50 th	95 th	50 th	95 th	50 th
Average	84.3%	613.0%	-17.6%	-5.6%	0.0%	0.0%
Minimum	-93.8%	-81.6%	-93.9%	-43.9%	0.0%	0.0%
Maximum	716.5%	2900.0%	-1.0%	0.0%	0.0%	0.0%

Coworker guidance documents also contain non-penetrating coworker dose models. Figures 2-3 and 2-4 illustrate a direct yearly comparison of non-penetrating dose for the 95th and 50th percentile coworker models, respectively.

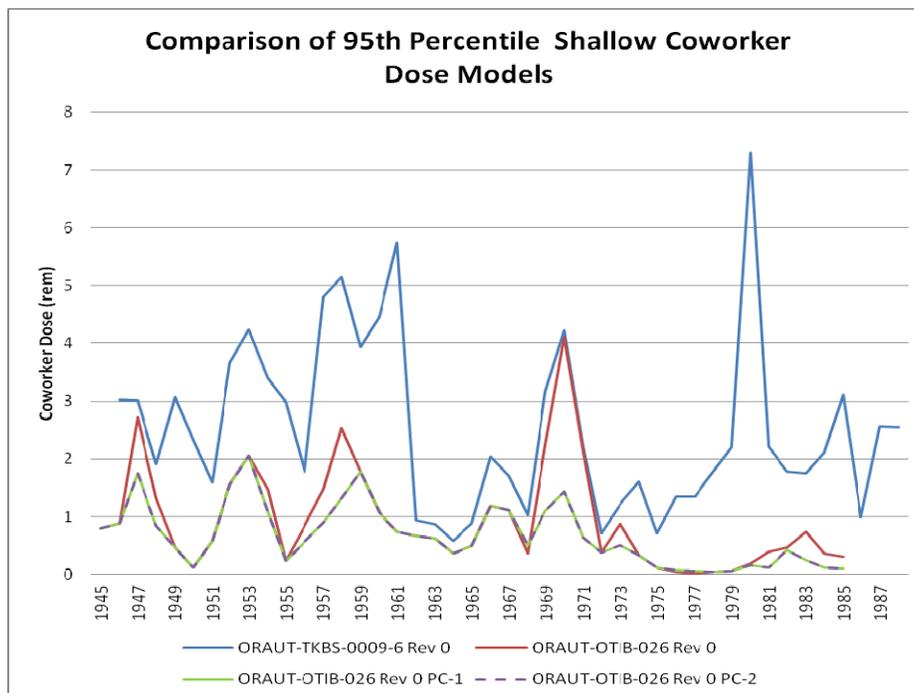


Figure 2-3. 95th Percentile Shallow Coworker Dose Comparison

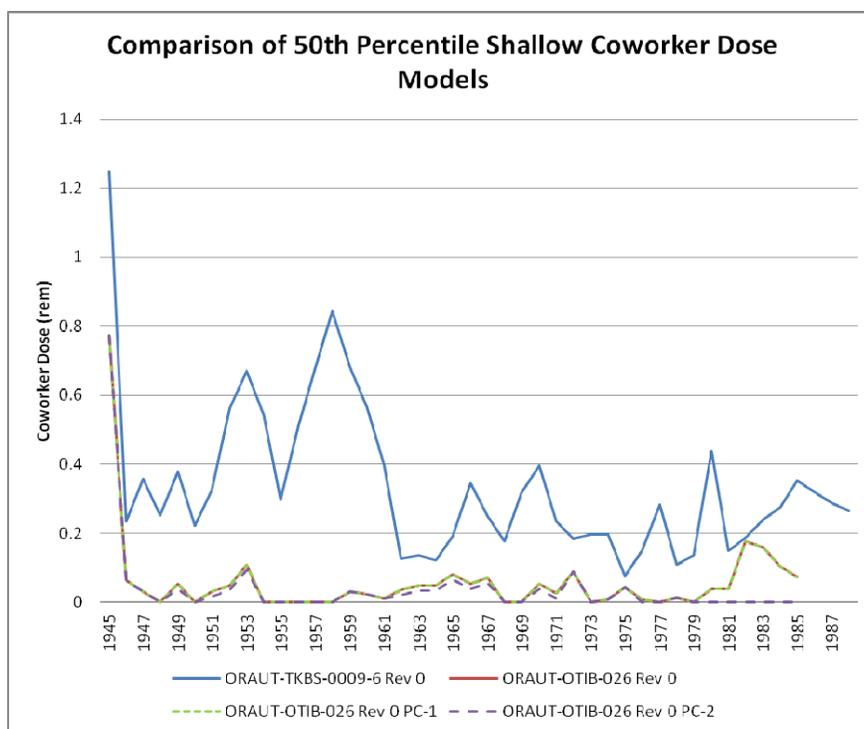


Figure 2-4. 50th Percentile Shallow Coworker Dose Comparison

Unlike the penetrating models, all historical shallow dose models overestimated shallow coworker dose when compared to the current coworker guidance contained in ORAUT-OTIB-0026 Rev. 00 PC-2. SC&A notes that use of the non-penetrating 50th percentile ORAUT-OTIB-0026 Rev. 00 coworker model during some years (1968, 1975–1976, and 1979) resulted in an underestimated dose when compared to the current coworker model. This has a potential impact only on cancers located on the skin, lip, breast and/or testicle for coworker dose assigned during 1968, 1975–1976, and 1979. Considering the fact that the corresponding 50th percentile penetrating dose model is an overestimate of dose compared to the current model, only a small impact on overall coworker dose would be expected. While NIOSH did not acknowledge this possibility in PER-011, SC&A does not anticipate that this would result in significant changes in any cases. No K-25 cases will require re-evaluation based solely on the shallow dose assigned.

The guidance document dose comparisons show that, in general, non-CTW penetrating coworker dose was overestimated by historical coworker models. The exception to this generality is the ORAUT-TKBS-0009-6 Rev. 00 non-CTW penetrating coworker dose models. It is evident from Table 2-1 that, on average, the yearly coworker models underestimated dose by 84.3% for the 95th percentile model and 613% for the 50th percentile model. Coworker dose calculated using either percentile from the ORAUT-TKBS-0009-6 Rev. 00 model would be underestimated compared to the current coworker model. Cases done using this guidance will require re-evaluation and possible rework.

2.2 SC&A'S COMMENTS ON CONSTRUCTION TRADES WORKER GUIDANCE CHANGES

Construction Trades Worker (CTW) coworker model guidance was not available until the issuance of ORAUT-OTIB-0052. As a result, many Energy Employees (EEs) with positions that are classified as construction trades may have received an underestimated coworker dose in comparison to DRs completed under current guidance. Using the updated ORAUT-OTIB-0026 (Rev. 00 PC-2), CTWs receive a measured coworker dose of 1.4 times greater than non-CTWs. Missed coworker dose is unaffected by this change. Note that the CTW coworker guidance contained in ORAUT-OTIB-0052 was reviewed by SC&A in *Draft Review of ORAUT-OTIB-0052, Revision 1: Parameters to Consider when Processing Claims for Construction Trade Workers* (SCA-TR-PR2011-0004, July 2011).

To quantify the possible impact on cases completed before CTW coworker model guidance was available, SC&A compared historical coworker models with the ORAUT-OTIB-0026, Rev. 00 PC-2 CTW model. The results of these comparisons are documented in Appendix D. For the convenience of the reader, a summary of these comparisons is provided in Table 2-2. **Red** and **green** texts are used for added emphasis to negative and positive percent changes, respectively.

Table 2-2. Summary of Percent Change Comparison of Historical Coworker Guidance to CTW Coworker Guidance

	95 th Percentile			50 th Percentile		
	ORAUT-TKBS-0009-6 Rev. 00	ORAUT-OTIB-0026 Rev. 00	ORAUT-OTIB-0026 Rev. 00 PC-1	ORAUT-TKBS-0009-6 Rev. 00	ORAUT-OTIB-0026 Rev. 00	ORAUT-OTIB-0026 Rev. 00 PC-1
Average	98.3%	-8.7%	10.7%	616.5%	-4.6%	1.1%
Min	-92.1%	-93.9%	0.0%	-81.6%	-43.9%	0.0%
Max	745.6%	17.8%	28.2%	2900.0%	13.9%	15.3%

SC&A's comparison shows that historical coworker models underestimated CTW coworker dose during most years prior to 1975. Thus, each CTW case where coworker dose was assigned using a historical model was likely underestimated.

SC&A finds it noteworthy that the ORAUT-TKBS-0009-6 and OCAS-OTIB-0026 Rev. 00 coworker models after 1975 significantly overestimated dose to CTWs in comparison to ORAUT-OTIB-0026 (Rev. 00 PC-2). If assigned coworker dose to CTWs began in 1975 or after and used these documents, the case would not require revision.

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3.0 SUBTASK 2: ASSESS NIOSH'S APPROACH AND METHODS FOR CORRECTIVE ACTION

NIOSH used the following set of criteria to determine the universe (or maximum potential number) of claims that could have been impacted by the K-25 coworker model document revisions:

- (1) Claim included employment at K-25
- (2) Claims were completed between the date of the initial coworker model (November 24, 2004) and the date of the issuance of ORAUT-OTIB-0052 (August 31, 2006)
- (3) Claim resulted in a POC of less than 50%

Using these criteria (as of September 2007), NIOSH identified a total of 432 cases from K-25 that were potentially impacted by revised coworker model guidance.

3.1 SC&A'S COMMENTS ON CORRECTIVE APPROACH

Critical to the successful implementation of OCAS-PER-011 is the accurate and complete identification of all potentially affected claims. In general, SC&A agrees with the methodology used by NIOSH to identify the 432 potentially affected claims. However, SC&A questions the dates selected to bound the potentially impacted claims. The start date (November 24, 2004) is the date ORAUT-TKBS-0009-6 Rev. 00 was issued. SC&A's concern involves those claims where the EE was unmonitored or inadequately monitored and their DR was adjudicated before the K-25 external coworker model was issued.

At the writing of this review, SC&A is unaware of any past effort by NIOSH that would have identified and assigned coworker doses to those claims that had been adjudicated before their site-specific coworker model had been issued in order to make them eligible for evaluation under OCAS-PER-011, or of a future effort to do so. If SC&A is correct in both assumptions, some cases may (1) have an incomplete DR and (2) be excluded from a revised DR, as provided by screening criteria cited in Section 3.0 above.

Finding #1 (Conditional): OCAS-PER-011 May Be Restrictive in Identifying All CTWs and Unmonitored Workers

At this time, there is uncertainty about the fate of claims where the EE was unmonitored or inadequately monitored and their DR had been adjudicated before the issuance of the K-25 coworker model. During our review, SC&A randomly identified several DRs completed prior to the issuance of the K-25 TBD, which included unmonitored/ambient external dose. However, these claims were not captured in the "universe" of potentially impacted claims under PER-011. This is considered a conditional finding, because there is uncertainty regarding the methods used to reconstruct the unmonitored dose for these cases. It should be noted that a similar finding was identified in SC&A's review of OCAS-PER-014, *A Review of NIOSH's Program Evaluation Report OCAS-PER-014, "Construction Trade Workers,"* SCA-TR-PR2012-0014. However, this finding was closed based on NIOSH's statement that cases requiring unmonitored dose were

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held pending a coworker model. SC&A wants to verify that NIOSH's response to that finding is accurate in these K-25 cases.

SC&A also questions the end date of August 31, 2006, being selected as the end of potentially affected claims. Although this is the date OTIB-0052 was issued, ORAUT-OTIB-0026 Rev. 00 PC-2, which incorporated provisions of OTIB-0052, was not issued until November 15, 2006. Missed and measured coworker dose is presented as a single value in the previous revision (ORAUT-OTIB-0026 Rev. 00 PC-1). In order for a DR to be properly implemented for a CTW, measured coworker dose must be adjusted separate from missed coworker dose. Using the guidance from OTIB-0052 and ORAUT-OTIB-0026 Rev. 00 PC-1, a DR would not be able to calculate CTW dose correctly unless the dose reconstructor was able to determine the measured versus missed portion of the external dose. SC&A believes it is unlikely that CTW coworker dose was assessed correctly prior to November 15, 2006.

As of March 26, 2013, SC&A identified 57 K-25 claims with DR "sent dates" between August 31, 2006, and November 15, 2006, and with POCs less than 50%. To determine if any cases within this window might have been missed by the PER-011 criteria end date, SC&A selected five cases at random with job titles matching those of CTWs. Three of the five cases had coworker dose assigned. All three cases had CTW coworker dose calculated incorrectly; a 1.4 correction factor (CF) was applied to both missed and measured CTW coworker dose. It should be noted that although calculated incorrectly, the means by which CTW dose was calculated resulted in a dose greater than otherwise would have been calculated. Since this resulted in an overestimate of dose, claims done in this time period would not require revision and can reasonably be excluded from the "universe" of claims potentially requiring revision.

Other than the start date concern addressed in Finding #1, SC&A agrees with the methodology used by NIOSH to identify the "universe" of claims potentially impacted by the revised coworker models at K-25.

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4.0 SUBTASK 3: EVALUATE THE PROGRAM EVALUATION REPORT'S STATED APPROACH FOR IDENTIFYING THE NUMBER OF DOSE RECONSTRUCTIONS REQUIRING RE-EVALUATION OF DOSE

NIOSH used the screening criteria listed in Section 3.0 to identify a universe of 432 potentially impacted claims. NIOSH will remove all cases that have been returned due to another PER and those that were returned for other reasons prior to evaluations. These claims are to be revised using the most current technical guidance, which includes coworker guidance; therefore, they do not require rework.

Each of the remaining claims should be reviewed by NIOSH to determine if external coworker data were used in the DR. NIOSH will request return for the following two reasons:

- (1) Claims completed before May 21, 2005, and completed using an external coworker model.
- (2) Claims completed between May 21, 2005, and August 31, 2006, using external coworker data and are deemed CTWs

Documentation will be provided to the Department of Labor (DOL) for cases that do not meet these criteria and therefore did not require rework.

4.1 SC&A'S COMMENTS ON SELECTION CRITERIA

SC&A identified that the selection criteria must capture two distinct sets of claims: non-CTW claims and CTW claims. Selection criteria for both types of claims are discussed separately below.

4.1.1 SC&A's Comments on Non-CTW Coworker Selection Criteria

The initial criterion includes all cases done with a coworker model prior to May 21, 2005. SC&A finds it interesting that NIOSH selected May 21, 2005, as the criterion end date, because ORAUT-OTIB-0026 Rev. 00 was not issued until May 31, 2005. In addition, since each DR report identifies numerous dates (i.e., "Calculation Performed," "Peer Review Completed," and "DR Approved"), SC&A is unsure which specific date NIOSH uses as the "completion date." SC&A believes the date the calculations were completed should be the completion date used by NIOSH. However, the NIOSH OCAS Claims Tracking System (NOCTS) database does not accommodate searches based on calculation completion date; therefore, SC&A cannot verify that all potentially impacted cases were captured.

Finding #2: Date Inconsistencies May Have Missed Non-CTW Coworkers

The end date of the first selection criteria, May 21, 2005, is 10 days before the issuance of ORAUT-OTIB-0026 Rev. 00. This may be an administrative oversight; however, it means any non-CTW cases completed in this 10-day window would not be captured by the selection criteria, and therefore not eligible for re-evaluation. NIOSH should investigate further to ensure

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no cases were inadvertently missed by this inconsistency. In addition, SC&A would like clarification regarding which date NIOSH considers the DR “completion date.”

Based on SC&A’s comparison of historical to current coworker guidance contained in Appendices A–C, any case (prior to 1975) that used the penetrating dose coworker model contained in ORAUT-TKBS-0009-6 underestimated potential coworker dose. Since the first criterion requires all cases completed using ORAUT-TKBS-0009-6 and having a coworker model should be sent to NIOSH for rework, SC&A has no concerns that any claims (other than those discussed in Finding #2) were missed if the first selection criterion was properly executed.

The second criterion specifically excludes non-CTWs and applies to cases done using the guidance of ORAUT-OTIB-0026 revisions. SC&A’s analysis of the early revisions of ORAUT-OTIB-0026 (discussed in Section 2.1 and Appendices A through C) shows that non-CTW cases completed using this guidance received a larger coworker dose than if they were completed with the current models from ORAUT-OTIB-0026 Rev. 00 PC-2. Since dose was overestimated by early ORAUT-OTIB-0026 models, case rework would not result in a higher POC. As such, these cases do not require revision.

Other than the first selection criterion’s end date discussed in Finding #2, SC&A finds the selection criteria to be inclusive of cases potentially impacted by the updates to coworker guidance.

4.1.2 SC&A’s Comments on CTW Selection Criteria

The first criterion captures all claims that include coworker dose and were completed prior to May 21, 2005. Since no career distinction is needed to trigger revision under this criterion, all CTW claims that use coworker dose and guidance from ORAUT-TKBS-0009-6 Rev. 00 will be captured. SC&A’s comparison discussed in Section 2.2 and documented in Appendix D shows that all CTW coworker doses (pre-1975) were underestimated by the ORAUT-TKBS-0009-6 Rev. 00 coworker model that predated CTW coworker guidance.

The second criterion requires that all CTW coworker claims completed between the issuance of ORAUT-OTIB-0026 Rev. 00 and OTIB-0052 be returned to NIOSH for re-evaluation. As shown in Appendix D, most newly identified CTW coworker claims are expected to have an increase in dose. Rework is required to determine the extent of this increase.

Finding #3: CTW Identification Method Not Specified

SC&A questions what technique NIOSH used to identify CTW claims. SC&A speculates that a keyword search method similar to the one used in OCAS-PER-014 to identify CTW claims was used; however, no information indicating how CTW cases were identified is given in PER-011. Since proper identification of CTW claims is a crucial element in ensuring that all impacted claims are evaluated and the term CTW is somewhat subjective, the technique used should be documented.

4.2 SC&A COMMENTS ON EXECUTION OF SELECTION CRITERIA

The extent to which NIOSH has screened and evaluated the universe of the 432 claims by means of the above-cited criteria was not discussed in OCAS-PER-011. As such, NIOSH did not identify the actual number of CTW claims (from among the 432 claims) eligible for a new DR. Because PER-011 was incomplete in this respect, SC&A requested that NIOSH provide a list of the 432 claims potentially impacted and the evaluation status of each claim. This list is summarized below.

Table 4-1. Summary of Impacted Claims

Number of Claims Impacted	Status	Meaning of Designation
94	Return to NIOSH	NIOSH requested the case be returned for a new DR
266	No Return necessary	NIOSH requested that the case NOT be returned for a new DR
41	Returned Prior to Evaluation	Case was returned to NIOSH prior to completing the PER Evaluation
31	Return Requested for another PER	NIOSH requested the case be returned based on a different PER

NIOSH identified 94 claims that met one of the two selection criteria and were returned, yet indicated to SC&A that only 69 of these claims were reworked. The remaining 25 claims were not revised. It appears that all returned cases have letters in their files stating the following:

It is not possible to determine the extent to which this claim is affected without reworking the case. NIOSH is therefore requesting the claim be returned for a new dose reconstruction. After the claim is returned, NIOSH will prepare a new dose reconstruction that applies all current methods. Because of this, no additional evaluations are necessary.

SC&A did not find any documentation in the 25 claims indicating why the claim was not revised. If NIOSH has no intention of revising these claims, it should be noted in the EE's files. Without this documentation, it appears that these cases are still awaiting revision, even though they have been returned to DOL.

Finding #4: Not All Cases Returned to NIOSH were Reworked, which May Result in Claims Not Being Considered under Other PERs

During the course of this review, SC&A noted that 25 cases were returned to NIOSH as a result of PER-011, but a revised DR was not performed for any of them. In reviewing the files for several of these 25 claims, it was determined that the cases were also potentially impacted by other recently issued PERs. For example, one case file contained an Individual Case Evaluation (ICE) memo for PER-011 stating, "The dose reconstruction for NIOSH ID [redacted] was re-evaluated in accordance with the above referenced Program Evaluation Report (PER) [OCAS-PER-011]", which is inaccurate. The case file also contains an ICE memo for OCAS-PER-014 indicating, "No evaluation was performed . . . because this claim has been returned or a return has been requested." Since this claim was not reworked under PER-011 (and revised using the

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most current technical guidance), it was also not considered under 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. Because of this, there is a possibility that all cases that are returned and not revised have been missed inadvertently by other PER evaluations. NIOSH needs to investigate this issue further.

Based on the broad selection criteria in PER-011, SC&A was surprised by how few cases were returned to NIOSH. For this reason, SC&A performed an independent screening of the 432 claims based on their job title, as listed in the NOCTS database, and the CTW screening criteria¹ specified in OCAS-PER-014, Appendix A. (It should be noted that OCAS-PER-014 has previously been reviewed by SC&A and was determined to adequately capture most CTW claims.) Using this technique, SC&A identified 162 (38%) of the 432 claims that reasonably could be deemed CTW cases. In this subset, 73 CTW claims were deemed "no return necessary" and 46 were returned to NIOSH.² Assuming the selection criteria were implemented correctly, this would mean that ~40% of CTW claims were for unmonitored EEs.

Based on SC&A's experience with DR reviews impacted by ORAUT-OTIB-0052, SC&A found this to be a particularly low number of cases. Therefore, SC&A selected 7 CTW claims at random (~10%) from those CTW cases that NIOSH deemed "no return necessary" to determine if they were monitored and coworker dose assigned. SC&A found the following:

- 2 cases – CTW was monitored and no coworker dose assigned
- 1 case – CTW was unmonitored and no coworker dose assigned
- 2 cases – CTW was unmonitored and assigned coworker dose for K-25
- 2 cases – CTW was simultaneously employed at other Oak Ridge facilities and assigned coworker dose from another facility

Based on the selection criteria identified in Section 3.0 of PER-011, four of the seven randomly selected cases should have been returned to NIOSH. These cases may or may not require rework; however, they should have been identified as potentially needing rework according to the selection criteria and sent back to NIOSH. This indicates NIOSH either used more definitive screening criteria than cited in PER-011 or the criteria were improperly applied.

Finding #5: Improper Application of Selection Criteria

Based on SC&A's initial screening of CTW claims deemed "no return necessary," it appears that selection criteria were not properly applied as stipulated in PER-011. Four of the seven claims screened should have been identified by the selection criteria listed in Section 3.0 of OCAS-PER-011 and returned to NIOSH for rework. SC&A previously noted that the selection criteria

¹ Several small changes were made to the criteria to better suit the data. These include changing "maintenance" to "maintenance," the addition of "ironworker"(iron worker already used), "construction," and "concrete" (cement already used).

² Remaining 43 CTW claims were returned for another PER (21) and returned prior to evaluation (22).

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were unnecessarily broad and unspecific. It is possible NIOSH used more definitive selection criteria than those listed in PER-011; however, use of any additional criteria should be documented. Further evaluation is needed to determine the number of claims that were missed due to the improper application of selection criteria.

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5.0 SUBTASK 4: CONDUCT AUDITS OF A SAMPLE-SET OF DOSE RECONSTRUCTIONS AFFECTED BY OCAS-PER-011

According to NIOSH, 69 cases were reworked in behalf of PER-011 and revised to include the most current technical guidance. However, selection of a sample of DRs affected by OCAS-PER-011 for audit by SC&A may at this time be premature and may have to await a discussion/resolution by the Subcommittee on Procedures Review regarding findings identified by SC&A in Sections 3 and 4 above. In particular, if it is determined that NIOSH improperly applied the PER-011 selection criteria, as discussed in Finding #5, the total number of claims impacted by this PER may increase.

On the assumption that the universe of claims remains at 69, SC&A recommends selection of at least 2 claims originally completed before May 31, 2005, using an external coworker model and revised as a result of PER-011. Additionally, SC&A recommends the selection of at least 2 CTW claims that were originally completed between May 21, 2005, and August 31, 2006, using external coworker data and revised as a result of PER-011.

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6.0 SUMMARY CONCLUSIONS

In behalf of the four subtasks evaluated under OCAS-PER-011, SC&A identified several findings that question the corrective actions taken by NIOSH. A summary of these findings is listed below.

- Finding #1(Conditional): OCAS-PER-011 May Be Restrictive in Identifying All CTWs and Unmonitored Workers
- Finding #2: Date Inconsistencies May Have Missed Non-CTW Coworkers
- Finding #3: CTW Identification Method Not Specified
- Finding #4: Not All Cases Returned to NIOSH were Reworked, which May Result in Claims Not Being Considered under Other PERs
- Finding #5: Improper Application of Selected Criteria

SC&A recommends that the selection of Subtask 4 cases be delayed until the Subcommittee on Procedures Review can further investigate SC&A's findings and concern that NIOSH's corrective actions did not adequately capture all impacted claims.

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APPENDIX A: COMPARISON OF ORAUT-TKBS-0009-6 REV. 00 COWORKER MODEL TO CURRENT GUIDANCE

The 95th and 50th percentile coworker models presented in ORAUT-TKBS-0009-6 Rev. 00 and ORAUT-OTIB-0026 Rev. 00 PC-2 are compared in Tables A-1 and A-2, respectively. ORAUT-TKBS-0009-6 Rev. 00 also contained a 99th percentile model; however, since ORAUT-OTIB-0026 Rev. 00 PC-2 does not have a 99th percentile model, no comparison was made.

Table A-1. Comparison of 95th Percentile Coworker Models

	ORAUT-TKBS-0009-6 Rev. 00 95th Percentile Penetrating Dose	ORAUT-OTIB-0026 Rev. 00 PC-2 95th Percentile Penetrating Dose	Penetrating Dose Percent Change	ORAUT-TKBS-0009-6 Rev. 00 95th Percentile Shallow Dose	ORAUT-OTIB-0026 Rev. 00 PC-2 95th Percentile Shallow Dose	Shallow Dose Percent Change
1945	*	1.29		*	0.802	
1946	1.198	1.455	21.5%	3.021	0.884	-70.7%
1947	0.412	1.015	146.4%	3.005	1.745	-41.9%
1948	0.712	1.264	77.5%	1.913	0.838	-56.2%
1949	0.629	1.035	64.5%	3.068	0.47	-84.7%
1950	2.209	0.841	-61.9%	2.331	0.115	-95.1%
1951	0.386	1.052	172.5%	1.599	0.582	-63.6%
1952	0.603	0.951	57.7%	3.656	1.549	-57.6%
1953	0.765	1.096	43.3%	4.245	2.053	-51.6%
1954	0.759	0.913	20.3%	3.399	1.088	-68.0%
1955	0.435	0.835	92.0%	2.98	0.237	-92.0%
1956	0.451	0.855	89.6%	1.777	0.566	-68.1%
1957	1.499	1.088	-27.4%	4.806	0.896	-81.4%
1958	2.035	1.049	-48.5%	5.153	1.325	-74.3%
1959	1.168	1.245	6.6%	3.929	1.775	-54.8%
1960	1.598	1.154	-27.8%	4.467	1.078	-75.9%
1961	0.898	0.942	4.9%	5.744	0.741	-87.1%
1962	0.133	0.824	519.5%	0.944	0.663	-29.8%
1963	0.106	0.84	692.5%	0.866	0.619	-28.5%
1964	0.103	0.841	716.5%	0.581	0.363	-37.5%
1965	0.236	0.936	296.6%	0.878	0.49	-44.2%
1966	0.33	0.952	188.5%	2.045	1.188	-41.9%
1967	0.345	0.928	169.0%	1.711	1.122	-34.4%
1968	0.575	0.906	57.6%	1.023	0.506	-50.5%
1969	0.429	0.946	120.5%	3.163	1.106	-65.0%
1970	0.487	1.041	113.8%	4.222	1.436	-66.0%
1971	0.343	1.092	218.4%	2.207	0.635	-71.2%
1972	0.267	1.034	287.3%	0.706	0.381	-46.0%
1973	0.249	0.871	249.8%	1.219	0.515	-57.8%
1974	0.777	1.065	37.1%	1.604	0.339	-78.9%
1975	0.191	0.111	-41.9%	0.713	0.119	-83.3%
1976	0.963	0.149	-84.5%	1.353	0.069	-94.9%
1977	1.157	0.089	-92.3%	1.348	0.058	-95.7%
1978	0.673	0.136	-79.8%	1.763	0.043	-97.6%
1979	1.231	0.088	-92.9%	2.193	0.063	-97.1%
1980	2.346	0.145	-93.8%	7.308	0.16	-97.8%
1981	0.884	0.085	-90.4%	2.212	0.12	-94.6%
1982	0.607	0.06	-90.1%	1.778	0.425	-76.1%
1983	0.439	0.06	-86.3%	1.75	0.245	-86.0%
1984	0.412	0.06	-85.4%	2.117	0.125	-94.1%
1985	0.497	0.06	-87.9%	3.116	0.105	-96.6%
1986	0.786	*		0.984	*	
1987	0.631	*		2.563	*	
1988	0.696	*		2.547	*	
Average			84.3%			-69.7%
Min			-93.8%			-28.5%
Max			716.5%			-97.8%

* No 95th percentile coworker model for year

Table A-2. Comparison of 50th Percentile Coworker Models

	ORAUT-TKBS-0009-6 Rev. 00 50 th Percentile Penetrating Dose	ORAUT-OTIB-0026 Rev. 00 PC-2 50 th Percentile Penetrating Dose	Penetrating Dose Percent Change	ORAUT-TKBS-0009-6 Rev. 00 50 th Percentile Shallow Dose	ORAUT-OTIB-0026 Rev. 00 PC-2 50 th Percentile Shallow Dose	Shallow Dose Percent Change
1945	0.475	1.24	161.1%	1.248	0.773	-38.1%
1946	0.161	0.805	400.0%	0.234	0.065	-72.2%
1947	0.086	0.78	807.0%	0.359	0.03	-91.6%
1948	0.096	0.78	712.5%	0.252	0	-100.0%
1949	0.145	0.78	437.9%	0.379	0.04	-89.4%
1950	0.186	0.78	319.4%	0.222	0	-100.0%
1951	0.132	0.78	490.9%	0.326	0.015	-95.4%
1952	0.118	0.78	561.0%	0.563	0.035	-93.8%
1953	0.15	0.78	420.0%	0.67	0.095	-85.8%
1954	0.164	0.78	375.6%	0.544	0	-100.0%
1955	0.093	0.78	738.7%	0.299	0	-100.0%
1956	0.14	0.78	457.1%	0.512	0	-100.0%
1957	0.278	0.78	180.6%	0.681	0	-100.0%
1958	0.297	0.78	162.6%	0.843	0	-100.0%
1959	0.192	0.81	321.9%	0.68	0.03	-95.6%
1960	0.19	0.791	316.3%	0.565	0.024	-95.8%
1961	0.089	0.778	774.2%	0.399	0.01	-97.5%
1962	0.032	0.78	2337.5%	0.128	0.022	-82.8%
1963	0.036	0.78	2066.7%	0.138	0.033	-76.1%
1964	0.026	0.78	2900.0%	0.121	0.034	-71.9%
1965	0.065	0.78	1100.0%	0.191	0.066	-65.4%
1966	0.059	0.78	1222.0%	0.345	0.04	-88.4%
1967	0.068	0.78	1047.1%	0.251	0.056	-77.7%
1968	0.079	0.78	887.3%	0.177	0	-100.0%
1969	0.07	0.78	1014.3%	0.317	0	-100.0%
1970	0.099	0.78	687.9%	0.397	0.038	-90.4%
1971	0.066	0.78	1081.8%	0.234	0.01	-95.7%
1972	0.063	0.779	1136.5%	0.185	0.088	-52.4%
1973	0.045	0.78	1633.3%	0.196	0	-100.0%
1974	0.122	0.835	584.4%	0.196	0.008	-95.9%
1975	0.025	0.062	148.0%	0.076	0.043	-43.4%
1976	0.125	0.06	-52.0%	0.149	0	-100.0%
1977	0.326	0.06	-81.6%	0.282	0	-100.0%
1978	0.097	0.052	-46.4%	0.108	0.013	-88.0%
1979	0.118	0.06	-49.2%	0.136	0	-100.0%
1980	0.126	0.06	-52.4%	0.438	0	-100.0%
1981	0.07	0.06	-14.3%	0.15	0	-100.0%
1982	0.061	0.06	-1.6%	0.187	0	-100.0%
1983	0.068	0.06	-11.8%	0.241	0	-100.0%
1984	0.051	0.06	17.6%	0.274	0	-100.0%
1985	0.141	0.06	-57.4%	0.353	0	-100.0%
1986	0.383	*		0.321	*	
1987	0.249	*		0.288	*	
1988	0.243	*		0.264	*	
Average			613.0%			-89.8%
Min			-81.6%			-100.0%
Max			2900.0%			-38.1%

* No 50th percentile coworker model for year

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APPENDIX B: COMPARISON OF ORAUT-OTIB-0026 REV. 00 COWORKER MODEL TO CURRENT MODEL

The 95th and 50th percentile coworker models presented in ORAUT-OTIB-0026 Rev. 00 and ORAUT-OTIB-0026 Rev. 00 PC-2 are compared in Tables B-1 and B-2, respectively. ORAUT-OTIB-0026 Rev. 00 also contained a 99th percentile model; however, since ORAUT-OTIB-0026 Rev. 00 PC-2 does not have a 99th percentile model, no comparison was made.

Table B-1. Comparison of 95th Percentile Coworker Models

	ORAUT-OTIB-0026 Rev. 00 95 th Percentile Penetrating Dose	ORAUT-OTIB-0026 Rev. 00 PC-2 95 th Percentile Penetrating Dose	Penetrating Dose Percent Change	ORAUT-OTIB-0026 Rev. 00 95 th Percentile Shallow Dose	ORAUT-OTIB-0026 Rev. 00 PC-2 95 th Percentile Shallow Dose	Shallow Dose Percent Change
1945	1.305	1.290	-1.1%	0.802	0.802	0.0%
1946	1.47	1.455	-1.0%	0.884	0.884	0.0%
1947	1.03	1.015	-1.5%	2.714	1.745	-35.7%
1948	1.279	1.264	-1.2%	1.325	0.838	-36.8%
1949	1.05	1.035	-1.4%	0.47	0.47	0.0%
1950	0.856	0.841	-1.8%	0.115	0.115	0.0%
1951	1.067	1.052	-1.4%	0.582	0.582	0.0%
1952	0.966	0.951	-1.6%	1.56	1.549	-0.7%
1953	1.111	1.096	-1.4%	2.053	2.053	0.0%
1954	0.928	0.913	-1.6%	1.475	1.088	-26.2%
1955	0.85	0.835	-1.8%	0.237	0.237	0.0%
1956	0.87	0.855	-1.7%	0.842	0.566	-32.8%
1957	1.103	1.088	-1.4%	1.482	0.896	-39.5%
1958	1.064	1.049	-1.4%	2.526	1.325	-47.5%
1959	1.26	1.245	-1.2%	1.775	1.775	0.0%
1960	1.169	1.154	-1.3%	1.078	1.078	0.0%
1961	0.957	0.942	-1.6%	0.741	0.741	0.0%
1962	0.839	0.824	-1.8%	0.663	0.663	0.0%
1963	0.855	0.840	-1.8%	0.619	0.619	0.0%
1964	0.856	0.841	-1.8%	0.363	0.363	0.0%
1965	0.951	0.936	-1.6%	0.49	0.49	0.0%
1966	0.967	0.952	-1.6%	1.189	1.188	-0.1%
1967	0.943	0.928	-1.6%	1.122	1.122	0.0%
1968	1.061	0.906	-14.6%	0.366	0.506	38.3%
1969	0.961	0.946	-1.6%	2.242	1.106	-50.7%
1970	1.056	1.041	-1.4%	4.103	1.436	-65.0%
1971	1.107	1.092	-1.4%	2.109	0.635	-69.9%
1972	1.049	1.034	-1.4%	0.381	0.381	0.0%
1973	0.886	0.871	-1.7%	0.888	0.515	-42.0%
1974	1.08	1.065	-1.4%	0.339	0.339	0.0%
1975	0.126	0.111	-11.9%	0.119	0.119	0.0%
1976	0.227	0.149	-34.4%	0.041	0.069	68.3%
1977	0.2	0.089	-55.5%	0.018	0.058	222.2%
1978	0.151	0.136	-9.9%	0.043	0.043	0.0%
1979	0.14	0.088	-37.1%	0.059	0.063	6.8%
1980	0.48	0.145	-69.8%	0.192	0.16	-16.7%
1981	0.48	0.085	-82.3%	0.398	0.12	-69.8%
1982	0.65	0.060	-90.8%	0.47	0.425	-9.6%
1983	0.56	0.060	-89.3%	0.742	0.245	-67.0%
1984	0.99	0.060	-93.9%	0.37	0.125	-66.2%
1985	0.48	0.060	-87.5%	0.308	0.105	-65.9%
Average			-17.6%			-9.9%
Min			-93.9%			-69.9%
Max			-1.0%			222.2%

Table B-2. Comparison of 50th Percentile Coworker Models

	ORAUT-OTIB-0026 Rev. 00 50th Percentile Penetrating Dose	ORAUT-OTIB-0026 Rev. 00 PC-2 50th Percentile Penetrating Dose	Penetrating Dose Percent Change	ORAUT-OTIB-0026 Rev. 00 50th Percentile Shallow Dose	ORAUT-OTIB-0026 Rev. 00 PC-2 50th Percentile Shallow Dose	Shallow Dose Percent Change
1945	1.255	1.24	-1.2%	0.773	0.773	0.0%
1946	0.82	0.805	-1.8%	0.065	0.065	0.0%
1947	0.795	0.78	-1.9%	0.03	0.03	0.0%
1948	0.78	0.78	0.0%	0	0	
1949	0.78	0.78	0.0%	0.055	0.04	-27.3%
1950	0.78	0.78	0.0%	0	0	
1951	0.78	0.78	0.0%	0.03	0.015	-50.0%
1952	0.78	0.78	0.0%	0.05	0.035	-30.0%
1953	0.78	0.78	0.0%	0.11	0.095	-13.6%
1954	0.78	0.78	0.0%	0	0	
1955	0.78	0.78	0.0%	0	0	
1956	0.78	0.78	0.0%	0	0	
1957	0.78	0.78	0.0%	0	0	
1958	0.78	0.78	0.0%	0	0	
1959	0.825	0.81	-1.8%	0.03	0.03	0.0%
1960	0.806	0.791	-1.9%	0.024	0.024	0.0%
1961	0.793	0.778	-1.9%	0.01	0.01	0.0%
1962	0.78	0.78	0.0%	0.037	0.022	-40.5%
1963	0.78	0.78	0.0%	0.048	0.033	-31.3%
1964	0.78	0.78	0.0%	0.049	0.034	-30.6%
1965	0.78	0.78	0.0%	0.081	0.066	-18.5%
1966	0.78	0.78	0.0%	0.055	0.04	-27.3%
1967	0.78	0.78	0.0%	0.071	0.056	-21.1%
1968	0.78	0.78	0.0%	0	0	
1969	0.78	0.78	0.0%	0	0	
1970	0.78	0.78	0.0%	0.053	0.038	-28.3%
1971	0.78	0.78	0.0%	0.025	0.01	-60.0%
1972	0.794	0.779	-1.9%	0.088	0.088	0.0%
1973	0.78	0.78	0.0%	0	0	
1974	0.85	0.835	-1.8%	0.008	0.008	0.0%
1975	0.077	0.062	-19.5%	0.043	0.043	0.0%
1976	0.06	0.06	0.0%	0.008	0	-100.0%
1977	0.06	0.06	0.0%	0	0	
1978	0.067	0.052	-22.4%	0.013	0.013	0.0%
1979	0.06	0.06	0.0%	0	0	
1980	0.08	0.06	-25.0%	0.04	0	-100.0%
1981	0.06	0.06	0.0%	0.04	0	-100.0%
1982	0.103	0.06	-41.7%	0.177	0	-100.0%
1983	0.08	0.06	-25.0%	0.16	0	-100.0%
1984	0.097	0.06	-38.1%	0.103	0	-100.0%
1985	0.107	0.06	-43.9%	0.073	0	-100.0%
Average			-5.6%			-37.2%
Min			-43.9%			-100.0%
Max			0.0%			0.0%

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APPENDIX C: COMPARISON OF ORAUT-OTIB-0026 REV. 00 PC-1 COWORKER MODEL TO CURRENT MODEL

The 95th and 50th percentile coworker models presented in ORAUT-OTIB-0026 Rev. 00 PC-1 and ORAUT-OTIB-0026 Rev. 00 PC-2 are compared in Tables C-1 and C-2, respectively. During most years, the models are the same yearly coworker dose. The 50th percentile shallow dose models do have some differences.

Table C-1. Comparison of 95th Percentile Coworker Models

	ORAUT-OTIB-0026 Rev. 00 PC-1 95th Percentile Penetrating Dose	ORAUT-OTIB-0026 Rev. 00 PC-2 95th Percentile Penetrating Dose	Penetrating Dose Percent Change	ORAUT-OTIB-0026 Rev. 00 PC-1 95th Percentile Shallow Dose	ORAUT-OTIB-0026 Rev. 00 PC-2 95th Percentile Shallow Dose	Shallow Dose Percent Change
1945	1.29	1.290	0.0%	0.802	0.802	0.0%
1946	1.455	1.455	0.0%	0.884	0.884	0.0%
1947	1.015	1.015	0.0%	1.745	1.745	0.0%
1948	1.264	1.264	0.0%	0.838	0.838	0.0%
1949	1.035	1.035	0.0%	0.47	0.47	0.0%
1950	0.841	0.841	0.0%	0.115	0.115	0.0%
1951	1.052	1.052	0.0%	0.582	0.582	0.0%
1952	0.951	0.951	0.0%	1.549	1.549	0.0%
1953	1.096	1.096	0.0%	2.053	2.053	0.0%
1954	0.913	0.913	0.0%	1.088	1.088	0.0%
1955	0.835	0.835	0.0%	0.237	0.237	0.0%
1956	0.855	0.855	0.0%	0.566	0.566	0.0%
1957	1.088	1.088	0.0%	0.896	0.896	0.0%
1958	1.049	1.049	0.0%	1.325	1.325	0.0%
1959	1.245	1.245	0.0%	1.775	1.775	0.0%
1960	1.154	1.154	0.0%	1.078	1.078	0.0%
1961	0.942	0.942	0.0%	0.741	0.741	0.0%
1962	0.824	0.824	0.0%	0.663	0.663	0.0%
1963	0.84	0.840	0.0%	0.619	0.619	0.0%
1964	0.841	0.841	0.0%	0.363	0.363	0.0%
1965	0.936	0.936	0.0%	0.49	0.49	0.0%
1966	0.952	0.952	0.0%	1.188	1.188	0.0%
1967	0.928	0.928	0.0%	1.122	1.122	0.0%
1968	0.906	0.906	0.0%	0.506	0.506	0.0%
1969	0.946	0.946	0.0%	1.106	1.106	0.0%
1970	1.041	1.041	0.0%	1.436	1.436	0.0%
1971	1.092	1.092	0.0%	0.635	0.635	0.0%
1972	1.034	1.034	0.0%	0.381	0.381	0.0%
1973	0.871	0.871	0.0%	0.515	0.515	0.0%
1974	1.065	1.065	0.0%	0.339	0.339	0.0%
1975	0.111	0.111	0.0%	0.119	0.119	0.0%
1976	0.149	0.149	0.0%	0.069	0.069	0.0%
1977	0.089	0.089	0.0%	0.058	0.058	0.0%
1978	0.136	0.136	0.0%	0.043	0.043	0.0%
1979	0.088	0.088	0.0%	0.063	0.063	0.0%
1980	0.145	0.145	0.0%	0.16	0.16	0.0%
1981	0.085	0.085	0.0%	0.12	0.12	0.0%
1982	0.06	0.060	0.0%	0.425	0.425	0.0%
1983	0.06	0.060	0.0%	0.245	0.245	0.0%
1984	0.06	0.060	0.0%	0.125	0.125	0.0%
1985	0.06	0.060	0.0%	0.105	0.105	0.0%
Average			0.0%			0.0%
Min			0.0%			0.0%
Max			0.0%			0.0%

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Table C-2. Comparison of 50th Percentile Coworker Models

	ORAUT-OTIB-0026 Rev. 00 PC-1 50th Percentile Penetrating Dose	ORAUT-OTIB-0026 Rev. 00 PC-2 50th Percentile Penetrating Dose	Penetrating Dose Percent Change	ORAUT-OTIB-0026 Rev. 00 PC-1 50th Percentile Shallow Dose	ORAUT-OTIB-0026 Rev. 00 PC-2 50th Percentile Shallow Dose	Shallow Dose Percent Change
1945	1.24	1.24	0.0%	0.773	0.773	0.0%
1946	0.805	0.805	0.0%	0.065	0.065	0.0%
1947	0.78	0.78	0.0%	0.03	0.03	0.0%
1948	0.78	0.78	0.0%	0	0	0.0%
1949	0.78	0.78	0.0%	0.055	0.04	-27.3%
1950	0.78	0.78	0.0%	0	0	0.0%
1951	0.78	0.78	0.0%	0.03	0.015	-50.0%
1952	0.78	0.78	0.0%	0.05	0.035	-30.0%
1953	0.78	0.78	0.0%	0.11	0.095	-13.6%
1954	0.78	0.78	0.0%	0	0	0.0%
1955	0.78	0.78	0.0%	0	0	0.0%
1956	0.78	0.78	0.0%	0	0	0.0%
1957	0.78	0.78	0.0%	0	0	0.0%
1958	0.78	0.78	0.0%	0	0	0.0%
1959	0.81	0.81	0.0%	0.03	0.03	0.0%
1960	0.791	0.791	0.0%	0.024	0.024	0.0%
1961	0.778	0.778	0.0%	0.01	0.01	0.0%
1962	0.78	0.78	0.0%	0.037	0.022	-40.5%
1963	0.78	0.78	0.0%	0.048	0.033	-31.3%
1964	0.78	0.78	0.0%	0.049	0.034	-30.6%
1965	0.78	0.78	0.0%	0.081	0.066	-18.5%
1966	0.78	0.78	0.0%	0.055	0.04	-27.3%
1967	0.78	0.78	0.0%	0.071	0.056	-21.1%
1968	0.78	0.78	0.0%	0	0	0.0%
1969	0.78	0.78	0.0%	0	0	0.0%
1970	0.78	0.78	0.0%	0.053	0.038	-28.3%
1971	0.78	0.78	0.0%	0.025	0.01	-60.0%
1972	0.779	0.779	0.0%	0.088	0.088	0.0%
1973	0.78	0.78	0.0%	0	0	0.0%
1974	0.835	0.835	0.0%	0.008	0.008	0.0%
1975	0.062	0.062	0.0%	0.043	0.043	0.0%
1976	0.06	0.06	0.0%	0.008	0	-100.0%
1977	0.06	0.06	0.0%	0	0	0.0%
1978	0.052	0.052	0.0%	0.013	0.013	0.0%
1979	0.06	0.06	0.0%	0	0	0.0%
1980	0.06	0.06	0.0%	0.04	0	-100.0%
1981	0.06	0.06	0.0%	0.04	0	-100.0%
1982	0.06	0.06	0.0%	0.177	0	-100.0%
1983	0.06	0.06	0.0%	0.16	0	-100.0%
1984	0.06	0.06	0.0%	0.103	0	-100.0%
1985	0.06	0.06	0.0%	0.073	0	-100.0%
Average			0.0%			-26.3%
Min			0.0%			-100.0%
Max			0.0%			0.0%

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APPENDIX D: PERCENT CHANGE COMPARISON BETWEEN HISTORICAL COWORKER MODELS AND NEW CTW COWORKER MODEL

Construction Trades Worker (CTW) coworker dose guidance was not available until the issue of ORAUT-OTIB-0052. As a result, many EEs with positions that fall in the construction trades may have received a coworker dose that underestimates dose when completed with current guidance. The K-25 historical coworker dose is compared with the CTW coworker guidance from ORAUT-OTIB-0026 Rev. 00 PC-2 in Tables D-1 and D-2, respectively. **Red** and **green** texts are used for added emphasis to negative and positive percent changes, respectively.

Table D-1. Percent Change Comparison of Historical 95th Percentile Coworker Models and ORAUT-OTIB-0052 CTW Coworker Model

	ORAUT-OTIB-0026 Rev. 00 PC-2	ORAUT-TKBS-0009-6 Rev. 00		ORAUT-OTIB-0026 Rev. 00		ORAUT-OTIB-0026 Rev. 00 PC-1	
		95 th %	% Change	95 th %	% Change	95 th %	% Change
1945	1.499	**		1.305	14.9%	1.29	16.2%
1946	1.731	1.198	44%	1.47	17.8%	1.455	19.0%
1947	1.115	0.412	171%	1.03	8.3%	1.015	9.9%
1948	1.463	0.712	105%	1.279	14.4%	1.264	15.7%
1949	1.143	0.629	82%	1.05	8.9%	1.035	10.4%
1950	0.871	2.209	-61%	0.856	1.8%	0.841	3.6%
1951	1.166	0.386	202%	1.067	9.3%	1.052	10.8%
1952	1.025	0.603	70%	0.966	6.1%	0.951	7.8%
1953	1.228	0.765	61%	1.111	10.5%	1.096	12.0%
1954	0.972	0.759	28%	0.928	4.7%	0.913	6.5%
1955	0.863	0.435	98%	0.85	1.5%	0.835	3.4%
1956	0.891	0.451	98%	0.87	2.4%	0.855	4.2%
1957	1.217	1.499	-19%	1.103	10.3%	1.088	11.9%
1958	1.163	2.035	-43%	1.064	9.3%	1.049	10.9%
1959	1.436	1.168	23%	1.26	14.0%	1.245	15.3%
1960	1.309	1.598	-18%	1.169	12.0%	1.154	13.4%
1961	1.013	0.898	13%	0.957	5.9%	0.942	7.5%
1962	0.848	0.133	538%	0.839	1.1%	0.824	2.9%
1963	0.87	0.106	721%	0.855	1.8%	0.84	3.6%
1964	0.871	0.103	746%	0.856	1.8%	0.841	3.6%
1965	1.004	0.236	325%	0.951	5.6%	0.936	7.3%
1966	1.027	0.33	211%	0.967	6.2%	0.952	7.9%
1967	0.993	0.345	188%	0.943	5.3%	0.928	7.0%
1968	0.962	0.575	67%	1.061	-9.3%	0.906	6.2%
1969	1.018	0.429	137%	0.961	5.9%	0.946	7.6%
1970	1.151	0.487	136%	1.056	9.0%	1.041	10.6%
1971	1.222	0.343	256%	1.107	10.4%	1.092	11.9%
1972	1.142	0.267	328%	1.049	8.9%	1.034	10.4%
1973	0.913	0.249	267%	0.886	3.0%	0.871	4.8%
1974	1.184	0.777	52%	1.08	9.6%	1.065	11.2%
1975	0.137	0.191	-28%	0.126	8.7%	0.111	23.4%
1976	0.191	0.963	-80%	0.227	-15.9%	0.149	28.2%
1977	0.107	1.157	-91%	0.2	-46.5%	0.089	20.2%
1978	0.172	0.673	-74%	0.151	13.9%	0.136	26.5%
1979	0.105	1.231	-91%	0.14	-25.0%	0.088	19.3%
1980	0.185	2.346	-92%	0.48	-61.5%	0.145	27.6%
1981	0.101	0.884	-89%	0.48	-79.0%	0.085	18.8%
1982	0.06	0.607	-90%	0.65	-90.8%	0.06	0.0%
1983	0.06	0.439	-86%	0.56	-89.3%	0.06	0.0%
1984	0.06	0.412	-85%	0.99	-93.9%	0.06	0.0%
1985	0.06	0.497	-88%	0.48	-87.5%	0.06	0.0%
Average			98.3%		-8.7%		10.7%
Min			-92.1%		-93.9%		0.0%
Max			745.6%		17.8%		28.2%

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Table D-2. Percent Change Comparison of Historical 50th Percentile Coworker Models and ORAUT-OTIB-0052 CTW Coworker Model

	ORAUT-OTIB-0026 Rev. 00 PC-2		ORAUT-TKBS-0009-6 Rev. 00		ORAUT-OTIB-0026 Rev. 00		ORAUT-OTIB-0026 Rev. 00 PC-21	
		50 th %	% Change	50 th %	% Change	50 th %	% Change	
1945	1.43	0.475	201%	1.255	13.9%	1.24	15.3%	
1946	0.821	0.161	410%	0.82	0.1%	0.805	2.0%	
1947	0.786	0.086	814%	0.795	-1.1%	0.78	0.8%	
1948	0.78	0.096	713%	0.78	0.0%	0.78	0.0%	
1949	0.78	0.145	438%	0.78	0.0%	0.78	0.0%	
1950	0.78	0.186	319%	0.78	0.0%	0.78	0.0%	
1951	0.78	0.132	491%	0.78	0.0%	0.78	0.0%	
1952	0.78	0.118	561%	0.78	0.0%	0.78	0.0%	
1953	0.78	0.15	420%	0.78	0.0%	0.78	0.0%	
1954	0.78	0.164	376%	0.78	0.0%	0.78	0.0%	
1955	0.78	0.093	739%	0.78	0.0%	0.78	0.0%	
1956	0.78	0.14	457%	0.78	0.0%	0.78	0.0%	
1957	0.78	0.278	181%	0.78	0.0%	0.78	0.0%	
1958	0.78	0.297	163%	0.78	0.0%	0.78	0.0%	
1959	0.828	0.192	331%	0.825	0.4%	0.81	2.2%	
1960	0.801	0.19	322%	0.806	-0.6%	0.791	1.3%	
1961	0.783	0.089	780%	0.793	-1.3%	0.778	0.6%	
1962	0.78	0.032	2338%	0.78	0.0%	0.78	0.0%	
1963	0.78	0.036	2067%	0.78	0.0%	0.78	0.0%	
1964	0.78	0.026	2900%	0.78	0.0%	0.78	0.0%	
1965	0.78	0.065	1100%	0.78	0.0%	0.78	0.0%	
1966	0.78	0.059	1222%	0.78	0.0%	0.78	0.0%	
1967	0.78	0.068	1047%	0.78	0.0%	0.78	0.0%	
1968	0.78	0.079	887%	0.78	0.0%	0.78	0.0%	
1969	0.78	0.07	1014%	0.78	0.0%	0.78	0.0%	
1970	0.78	0.099	688%	0.78	0.0%	0.78	0.0%	
1971	0.78	0.066	1082%	0.78	0.0%	0.78	0.0%	
1972	0.785	0.063	1146%	0.794	-1.1%	0.779	0.8%	
1973	0.78	0.045	1633%	0.78	0.0%	0.78	0.0%	
1974	0.863	0.122	607%	0.85	1.5%	0.835	3.4%	
1975	0.069	0.025	176%	0.077	-10.4%	0.062	11.3%	
1976	0.06	0.125	-52%	0.06	0.0%	0.06	0.0%	
1977	0.06	0.326	-82%	0.06	0.0%	0.06	0.0%	
1978	0.055	0.097	-43%	0.067	-17.9%	0.052	5.8%	
1979	0.06	0.118	-49%	0.06	0.0%	0.06	0.0%	
1980	0.06	0.126	-52%	0.08	-25.0%	0.06	0.0%	
1981	0.06	0.07	-14%	0.06	0.0%	0.06	0.0%	
1982	0.06	0.061	-2%	0.103	-41.7%	0.06	0.0%	
1983	0.06	0.068	-12%	0.08	-25.0%	0.06	0.0%	
1984	0.06	0.051	18%	0.097	-38.1%	0.06	0.0%	
1985	0.06	0.141	-57%	11%	-44%	6%	0%	
Average			616.5%		-4.6%		1.1%	
Min			-81.6%		-43.9%		0.0%	
Max			2900.0%		13.9%		15.3%	

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