Summary of Seven Document Reviews Approved by the Subcommittee for Procedure Reviews

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Advisory Board on Radiation and Worker Health,
Subcommittee for Procedure Reviews

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SCPR-approved documents

- ORAUT-OTIB-0066, rev. 01, “Calculation of Dose from Intakes of Special Tritium Compounds”
- ORAUT-RPRT-0086, rev. 00, “Internal Dosimetry Coworker Data Completeness Test”
- DCAS-PER-057, rev. 0, “General Steel Industries”
- DCAS-PER-080, rev. 0, “General Steel Industries”
- DCAS-PER-063, rev. 0, “Aluminum Company of America – Pennsylvania (ALCOA-PN)
- DCAS-PER-065, rev. 0, “Anaconda”
- DCAS-PER-064, rev. 0, “DuPont Deep Water Works”

ORAUT-OTIB-0066, rev. 01

- Title: “Calculation of Dose from Intakes of Special Tritium Compounds”
- Provides guidance for the calculation of best estimate of organ doses for intakes of tritium bound to organically bound tritium (OBT) and stable metal tritide (SMT)
- Revision 00 issued April 26, 2007
- SC&A submitted its review of rev. 00 on November 25, 2008, and identified four findings
- Presented to the SCPR at the March 24, 2009, meeting
- Revision 01 issued October 15, 2020

Issue resolution for OTIB-0066, rev. 00, finding 1

Finding date	Finding description	NIOSH response	Finding resolution
11/25/2008	The recommendation given in OTIB-0066 to assess dose to intake of OBT using methodology in ORAUT-OTIB-0011 is not claimant favorable.	**1/23/2009.** NIOSH agrees. The 1.4 factor referenced in OTIB-0011 is correct for type 1 calculations on urinary excretion during a chronic intake, but the adjustment is larger for types 2 and 3 calculations. OTIB-0011 will be revised. **10/21/2020.** The recommendation to use OTIB-0011 to calculate doses from intakes of OBT has been removed in OTIB-0066, rev. 01, which now specifies that IMBA must be used for such assessments.	**4/28/2021.** SC&A performed a focused review of OTIB-0066, rev. 01, confirmed that appropriate changes were incorporated into rev. 01, and recommended closing the finding. **11/3/2021.** The SCPR agreed to close finding.

Issue resolution for OTIB-0066, rev. 00, finding 2

Finding date	Finding description	NIOSH response	Finding resolution
11/25/2008	Bounding techniques proposed in OTIB-0066 cannot be effectively developed and applied without understanding the special tritium compounds handled, material quantities, locations and time periods of potential exposure, and physical behaviors of tritium compounds in the environment.	**1/23/2009.** This finding is not within the scope of OTIB-0066 and should be addressed in the site profile.	**3/24/2009.** SC&A agreed with NIOSH response and recommending closing the finding. The SCPR closed the finding based on NIOSH's response and SC&A's recommendation.

Issue resolution for OTIB-0066, rev. 00, finding 3

Finding date	Finding description	NIOSH response	Finding resolution
11/25/2008	OTIB-0066 does not ensure that resultant doses are based on adequate monitoring data. The method of choice for personnel monitoring is particulate air monitoring; however, there are multiple issues with the use of these data.	**1/23/2009.** NIOSH agrees that air monitoring data are useful for evaluating SMT intakes. In the absence of such data, urine bioassay can be used to bound the SMT intake to the respiratory tract and systemic organs. NIOSH will add discussion of the practical interpretation and shortfalls of urinalysis results following an intake of SMT. **10/21/2020.** A paragraph was added to the Purpose section of rev. 01 that discusses the limitations associated with the use of urine sampling for quantifying SMT intakes.	**4/28/2021.** SC&A performed a focused review of OTIB-0066, rev. 01, confirmed that appropriate changes were incorporated into rev. 01, and recommended closing the finding. **11/3/2021.** The SCPR agreed to close finding

Issue resolution for OTIB-0066, rev. 00, finding 4

Finding date	Finding description	NIOSH response	Finding resolution
11/25/2008	The procedure provides no guidance on how to distinguish between intakes of special tritium compounds, elemental tritium, and/or tritiated water that occur simultaneously or overlap.	**1/23/2009.** It is not possible to identify the compound responsible, including excretion resulting from intakes. Most claimant-favorable models are consistent with the source terms.	**3/24/2009.** SC&A agreed with NIOSH's response and recommended closure. **11/3/2021.** The SCPR agreed to close finding.

Board discussion of ORAUT-OTIB-0066

ORAUT-RPRT-0086, rev. 00

- Title: “Internal Dosimetry Coworker Data Completeness Test”
- Evaluates the completeness of internal dosimetry data by providing a method to calculate the proportion of missing data for a given set of coworkers
- Revision 00 issued September 18, 2017
- SC&A submitted its review of rev. 00 on January 12, 2018, and identified three observations
- Presented review and discussed observations at SCPR meeting February 13, 2019

Issue resolution for RPRT-0086, rev. 00, observation 1

Observation date	Observation description	NIOSH response	Observation resolution
1/12/2018	Some RPRT-0086 parameters are variable, and selection of their values will determine the required sample sizes and may affect the outcome of analyses. These include: Parameter 1: Producer's risk α; Parameter 2: Consumer's risk β; Parameter 3: Acceptable error rate; Parameter 4: Unacceptable error rate.	**2/13/2019.** NIOSH indicated that they will note this observation, but it does not change the methodology used in the procedure. When the report is revised, NIOSH will add appropriate wording.	**2/13/2019.** The SCPR accepted NIOSH's response and closed the observation.

Issue resolution for RPRT-0086, rev. 00, observation 2

Observation date	Observation description	NIOSH response	Observation resolution
1/12/2018	"Original dataset" is used throughout document to refer to the computer-readable dataset in electronic form that has been transcribed from the hardcopy records. The term "original" generally refers to origin or first. A different term for the electronic dataset would be less confusing when reading RPRT-0086.	**2/13/2019.** NIOSH indicated that they will note this observation, but it does not change the methodology used in the procedure. When the report is revised, NIOSH will add appropriate wording.	**2/13/2019.** The SCPR accepted NIOSH's response and closed the observation.

Issue resolution for RPRT-0086, rev. 00, observation 3

Observation date	Observation description	NIOSH response	Observation resolution
1/12/2018	The last paragraph on page 11 states: "This process is illustrated in Figure 5-3, where, for example, the critical values for n = 25 are those shown in Figure 5-2." According to the caption for Figure 5-2, n = 24, not 25.	**2/13/2019.** NIOSH agreed that this is a typo, but it does not change the methodology used in the procedure. When the report is revised, NIOSH will correct this error.	**2/13/2019.** The SCPR accepted NIOSH's response and closed the observation.

Board discussion of ORAUT-RPRT-0086

DCAS-PER-057, rev. 0

- Title: “General Steel Industries” (GSI)
- Issued March 11, 2015
- Determines the effect of rev. 01 of the GSI appendix BB to Battelle-TBD-6000
- Extensive changes to dose estimate for each year of the operational and residual periods

SC&A's review of PER-057, rev. 0

- GSI appendix BB to TBD-6000, rev. 01, dated June 4, 2014, was reviewed separately
- PER-057 review consisted of only subtask 4 protocol for evaluation of a sample set of impacted cases
- SC&A reviewed five cases based on selection criteria that included employment period, job category, and cancer type
- SC&A submitted its subtask 4 report December 12, 2016
- SC&A's subtask 4 report identified four findings and seven observations
- SC&A presented review to the SCPR at the January 10, 2017, meeting

Issue resolution for PER-057 subtask 4, finding 1

Finding date	Finding description	NIOSH response	Finding resolution
12/12/2016	NIOSH incorrectly assigned the energy employee (EE) in one selected case to an Administrative category, which is inappropriate based on information provided in the CATI. To determine if this was a systemic issue, SC&A reviewed all GSI cases that were assigned in the Administrative category and concluded this was not widespread.	**1/10/2017.** After reviewing the CATI report for the EE, NIOSH agreed that the worker should not have been classified under the Administrative category. However, since the EE was not employed at the site, there is not much that can be done to correct the error.	**1/10/2017.** The SCPR closed the finding, since it appears that the incorrect job category selection was a unique situation.

Issue resolution for PER-057 subtask 4, finding 2

Finding date	Finding description	NIOSH response	Finding resolution
12/12/2016	Using CADW, NIOSH prorated intakes to account for partial years of employment. This approach for calculating internal doses is considered an efficiency measure that could have affected the compensation decision. SC&A recommends NIOSH use IMBA in these cases.	**1/10/2017.** NIOSH indicated that for best estimate cases, typically IMBA is used to calculate dose. NIOSH did recalculate the internal dose using IMBA and re-ran IREP. This resulted in a modest change in the POC, which had no impact on the case. NIOSH also indicated that CADW has been modified to allow for partial-year intakes. At the SCPR's request, NIOSH submitted a formal response documenting this issue.	**2/13/2019.** Based on the response provided by NIOSH, the SCPR closed the finding.

Issue resolution for PER-057 subtask 4, finding 3

Finding date	Finding description	NIOSH response	Finding resolution
12/12/2016	NIOSH used an incorrect end date in calculating intakes of uranium. An additional year of intake was included after the EE's date of employment. This error represents a quality assurance issue.	**1/10/2017.** NIOSH acknowledged that there was an error in the end date but indicated that it did not impact the case.	**1/10/2017.** The SCPR closed the finding.

Issue resolution for PER-057 subtask 4, finding 4

Finding date	Finding description	NIOSH response	Finding resolution
12/12/2016	NIOSH needs to perform further research to determine if the EE in the selected case should be reclassified as a Plant Worker rather than Administrative.	**1/10/2017.** NIOSH indicated that all of the GSI cases that were assigned under the Administrative category were re-reviewed to ensure that this classification was appropriate.	**1/10/2017.** The SCPR closed the finding.

Issue resolution for PER-057 subtask 4, observation 1

Observation date	Observation description	NIOSH response	Observation resolution
12/12/2016	NIOSH used a fixed value of the exposure-to-organ dose conversion factor (DCF) for assigning doses to Administrative personnel, which is inconsistent with the instructions in OCAS-IG-001.	**1/29/2021.** The GSI appendix, tools, and some techniques were revised, and NIOSH issued DCAS-PER-080. SC&A was tasked to review PER-080 and, based on that review, determined the observation was resolved.	**2/18/2021.** The SCPR closed the observation.

Issue resolution for PER-057 subtask 4, observation 2

Observation date	Observation description	NIOSH response	Observation resolution
12/12/2016	External photon doses during the residual period should be entered in IREP as chronic exposure rates.	**1/10/2017.** NIOSH selects acute versus chronic dose based on dose rate efficiency factors and typically selects the exposure mode that gives the highest POC.	**2/18/2021.** Based on NIOSH's explanation, the SCPR closed the observation.

Issue resolution for PER-057 subtask 4, observation 3

Observation date	Observation description	NIOSH response	Observation resolution
12/12/2016	NIOSH derived distributions of organ doses to operators during 1952–1961 by incorrectly assuming that exposure rates and DCFs were totally correlated.	**1/29/2021.** The GSI appendix, tools, and some techniques were revised, and NIOSH issued DCAS-PER-080. SC&A was tasked to review PER-080 and, based on that review, determined the observation was resolved.	**2/18/2021.** The SCPR closed the observation.

Issue resolution for PER-057 subtask 4, observation 4

Observation date	Observation description	NIOSH response	Observation resolution
12/12/2016	Appendix BB, revision 1, cannot be used to assign neutron doses.	**1/29/2021.** The GSI appendix, tools, and some techniques were revised, and NIOSH issued DCAS-PER-080. SC&A was tasked to review PER-080 and, based on that review, determined the observation was resolved.	**2/18/2021.** The SCPR closed the observation.

Issue resolution for PER-057 subtask 4, observation 5

Observation date	Observation description	NIOSH response	Observation resolution
12/12/2016	Beta doses to the skin during 1964–1966 should be entered in IREP as chronic exposures.	**1/29/2021.** NIOSH agrees that a chronic exposure rate is more accurate, but they typically assign acute, because it is more claimant favorable. Guidance document does not specify. If the case is a best estimate, NIOSH may use the more accurate chronic exposure.	**2/18/2021.** Based on NIOSH's explanation, the SCPR closed the observation.

Issue resolution for PER-057 subtask 4, observation 6

Observation date	Observation description	NIOSH response	Observation resolution
12/12/2016	NIOSH used efficiency measures, i.e., CADW, to estimate internal doses to the kidneys.	**2/18/2021.** Observation 6 is similar to finding 2, which was closed based on a NIOSH memo. SC&A was tasked to look at the finding 2 memo and provide response at the next meeting. **11/3/2021.** SC&A presented its 8/17/2021 memo, which indicated the observation was resolved since NIOSH agreed to use IMBA for best estimate cases.	**11/3/2021.** Based on NIOSH's response and SC&A's memo, the SCPR closed the observation.

Issue resolution for PER-057 subtask 4, observation 7

Observation date	Observation description	NIOSH response	Observation resolution
12/12/2016	NIOSH assigned medical x-ray exposures to a worker who stated that medical x-rays were not required as a condition of employment.	**1/29/2021.** The GSI appendix, tools, and some techniques were revised, and NIOSH issued DCAS-PER-080. SC&A was tasked to review PER-080 and, based on that review, determined the observation was resolved.	**2/18/2021.** The SCPR closed the observation.

Board discussion of DCAS-PER-057

DCAS-PER-080, rev. 0

- Title: “General Steel Industries”
- Issued August 30, 2017
- Determines the effect of revisions 02 and 03 of the GSI appendix BB to Battelle-TBD-6000
- 1966 operational period inhalation intakes increased and at least one prescribed external organ or skin dose for radiographers increased in each operational year

SC&A's review of PER-080, rev. 0

- GSI (appendix BB to TBD-6000), rev. 02, dated May 26, 2016, and rev. 03, dated February 9, 2017, were reviewed separately
- PER-080 review consisted of only evaluating a sample set of impacted cases
- SC&A reviewed five cases based on selection criteria that included periods of employment, job categories, and types of cancer
- SC&A submitted its subtask 4 report July 19, 2018
- SC&A's subtask 4 report identified one observation
- SC&A presented case review to SCPR at the February 13, 2019, meeting

Issue resolution for PER-080 subtask 4, observation 1

Observation date	Observation description	NIOSH response	Observation resolution
12/12/2016	Using CADW, NIOSH prorated intakes to account for partial years of employment. This approach for calculating internal doses is considered an efficiency measure that could have affected the compensation decision of cases with POCs close to 50%. SC&A recommends NIOSH use IMBA in these cases.	**2/13/2019.** NIOSH indicated that their prior statement that CADW would assess doses based on daily intakes was incorrect. CADW was actually modified to incorporate the prorating approach for partial-year intakes. To resolve this issue, the dose reconstructors have been instructed to use IMBA for any case with a POC between 45% and 52%.	**2/13/2019.** Based on the response provided by NIOSH, the SCPR closed the observation.

Board discussion of DCAS-PER-080

DCAS-PER-063, rev. 0

- Title: “Aluminum Company of America – Pennsylvania (ALCOA-PN)”
- Issued June 15, 2015
- Determines the effect of rev. 1 of appendix R to Battelle-TBD-6000
- Revision 1 changes:
  - incorporated TBD-6000 revisions
  - eliminated job categories (Operator, General Laborer, Supervisor, and Clerk) and assumes job title of Operator
  - included ORAUT-OTIB-0070 depletion factors during residual period
- Inhalation, ingestion, and external doses increased during operational period and some residual period doses increased through 1980

SC&A's review of PER-063, rev. 0

- SC&A submitted its review of PER-063 July 17, 2017
- No findings identified in the PER-063 review
- Presented review to TBD-6000 work group September 25, 2017
- Under subtask 4 protocol, SC&A reviewed one case where the EE was assigned internal and external doses during the operational and residual periods
- SC&A submitted its subtask 4 report September 2, 2021
- No findings identified in the review of one reworked case
- SC&A presented case review to SCPR November 3, 2021

ALCOA-PN facility history

- ALCOA used a unique welding process to “can” and seal uranium slugs produced by other facilities
- Work proceeded under 15 purchase orders, resulting in the canning of approximately 100,000 slugs
- The facility was listed as an Atomic Weapons Employer (AWE) from 1943 through 1945
- Residual phase consists of the time period from 1946 through 1991

SC&A's assessment of NIOSH's method for corrective actions in PER-063

- SC&A previously reviewed revisions to TBD-6000 and OTIB-0070
- PER-063 review compared original and revised TBD-6000, appendix R, as follows:
  - Operational period external whole body, hands and forearm, and other skin dose rates
  - Operational period inhalation and ingestion intakes
  - Residual period derived floor contamination levels
  - Residual period photon and beta dose rates
  - Residual period source depletion rate
  - Annual residual period external and internal doses based on source depletion factors

SC&A's conclusions on NIOSH's method for corrective actions in PER-063

- Confirmed that appropriate parameters from revised TBD-6000 and OTIB-0070 were applied
- SC&A able to match all rev. 1 operational dose rate and intake values
- Verified floor contamination levels and source depletion rates were correctly calculated
- Able to match rev. 1 residual dose rates and internal intakes

SC&A's evaluation of PER-063 approach to identify potentially affected dose reconstructions

- Initial identification of potentially affected cases performed by searching all ALCOA-PN cases with POCs less than 50%
- 44 total cases identified
  - Two claims eliminated since they were completed using rev. 1
  - Five claims completed using a complex-wide overestimating method, resulting in higher doses than rev. 1
  - Two claims were returned to NIOSH and reworked using rev. 1
- New dose estimates calculated for remaining 35 cases
- SC&A agrees with selection strategy and screening criteria

SC&A's recommendation for review of sample set of cases impacted by PER-063

- Under subtask 4 protocol, SC&A reviews a sample set of reevaluated cases to assess if appendix R, rev. 1, was implemented correctly
- Selection criteria:
  - EE assigned external exposure during the operational period
  - EE assigned internal exposure during the operational period
  - EE assigned external exposure during the residual period
  - EE assigned internal exposure during the residual period

Selection of PER-063 case review

- NIOSH identified one case that met all selection criteria
- NIOSH reworked the case
  - using applicable DR tools
  - recalculated all annual doses
  - re-ran Interactive RadioEpidemiological Program (IREP) 30 times at 10,000 iterations per run
- Rework of the case resulted in a POC between 45% and 50%
- Formal revised DR report not sent to Department of Labor (DOL) because the compensation decision did not change

PER-063 case background

- EE worked at ALCOA-PN for ~3 decades
- Worked throughout the facility
- Not monitored for radiation exposure
- Diagnosed with qualifying cancer ~20 years after termination of employment

Comparison of NIOSH's reworked doses and original doses for PER-063 case

Dose categories	Reworked vs. original dose percentage
External	1858% increase
Occupational medical	No change
Internal	1% decrease
Total	1055% increase
POC	906% increase

Original external dose calculations for PER-063 case

- Assumed “Plant Floor High” job category
- Used whole-body dose rates from table R.3 of appendix R, rev. 0, for operational and residual periods
- Applied DCF of 1.244 associated with bladder as surrogate organ
- Assigned dose to cancer site ~0.500 rem

Reworked external dose calculations for PER-063 case

- Used whole-body dose rates from table R.2 of appendix R, rev. 1, for operational and residual periods
- Applied DCF of 1.244 associated with bladder as surrogate organ
- Assigned dose to cancer site greater than 9.000 rem

Original occupational medical dose for PER-063 case

- Assumed pre-employment and annual chest x-rays during operational period
- Used dose for urinary bladder, as surrogate organ, from ORAUT-OTIB-0006, rev. 03 PC-1
- Assigned dose to cancer site less than 0.100 rem

Reworked occupational medical dose for PER-063 case

- Also assumed pre-employment and annual chest x-rays during operational period
- Used dose for urinary bladder, as surrogate organ, from ORAUT-OTIB-0006, rev. 06
- Assigned same dose to cancer site less than 0.100 rem

Original internal dose calculations for PER-063 case

- Assumed “Plant Floor High” job category
- Inhalation and ingestion of uranium material intake rate values for operational and residual periods from tables R.1 and R.2 of appendix R, rev. 0
- Used Integrated Modules for Bioassay Analysis (IMBA) program to calculate the inhaled and ingested dose from uranium
- Compared types M and S uranium, with type M resulting in higher dose
- Assigned dose to cancer site ~0.300 rem

Reworked internal dose calculations for PER-063 case

- Inhalation and ingestion of uranium material intake rate values for operational and residual periods from table R.1 of appendix R, rev. 1
- Used IMBA to calculate the inhaled and ingested dose from uranium
- Compared types M and S uranium, with type M resulting in higher dose
- Assigned dose to cancer site ~0.300 rem

SC&A's conclusions on PER-063 case

- External dose:
  - Correct doses selected from applicable tables with exception of one year, where NIOSH assigned slightly higher dose than listed in table R.2
  - Appropriate surrogate organ selected and associated DCF value applied
- Occupational medical dose:
  - Doses calculated for appropriate years of employment
  - Correct doses assigned from applicable table
- Internal dose:
  - Correct intake values selected except for one year, where NIOSH assigned slightly lower dose than identified in table R.1
  - Verified type M solubility results in higher dose
- Re-ran IREP 30 times at 10,000 iterations and confirmed POC less than 50%

Board discussion of DCAS-PER-063

DCAS-PER-065, rev. 0

- Title: “Anaconda”
- Issued November 30, 2015
- Determines the effect of rev. 1 of appendix G to TBD-6000
- Revision 1 incorporated changes to TBD-6000 and made dose estimates more consistent with existing techniques
- External doses increased for all job categories and all years of operation
- Although not explicitly stated, revision also incorporated OTIB-0070 (periods between extrusion operations) and OTIB-0006 (occupational medical dose) revisions

SC&A's review of PER-065, rev. 0

- SC&A submitted its review of PER-065 June 15, 2016, which included an evaluation of the dose reconstruction (DR) methods
- No findings identified in the PER-065 review
- Presented review to TBD-6000 work group September 25, 2017
- SC&A reviewed one case where EE was assigned external dose as an operator during the operational period and was assigned occupational medical dose
- SC&A submitted its subtask 4 report August 25, 2021
- No findings identified in the review of one reworked case
- Presented case review to SCPR November 3, 2021

Anaconda facility history

- Conducted 1956 pilot project where uranium billets were extruded to evaluate uranium extrusion procedures to manufacture uranium fuel
- 50 billets were extruded in March 1957
- Extrusion activities also took place in October 1959

SC&A's review of Anaconda DR methods

- Compared original and revised versions of TBD-6000, appendix G to ensure:
  - Revised appendix completely and accurately describes the AWE and post-AWE activities
  - Revision reflects all the site-specific information and data applicable to performing DRs
  - Revision uses the most recent generic guidance applicable to DRs at Anaconda (i.e., TBD-6000, OTIB-0070, and OTIB-0006)
  - Appendix makes use of all applicable information, data, and guidance in a scientifically sound and claimant-favorable manner

SC&A's conclusions on Anaconda DR methods

- Site profile accurately extracted and interpreted referenced data source information
- Evaluation of non-referenced data sources corroborated information from cited data sources
- SC&A agrees with NIOSH's assumptions and derivation of external and internal doses
- SC&A found one minor inconsistency in the appendix where the URL for the cited DOL website was incorrect

SC&A's evaluation of PER-065 approach to identify potentially affected DRs

- Initial identification of potentially affected cases performed by searching for all Anaconda cases with POCs less than 50%
- Ten cases were identified and new dose estimates calculated
- SC&A agrees with selection strategy

SC&A's recommendation for review of a sample set of cases impacted by PER-065

- Under the subtask 4 protocol, SC&A reviews a sample set of reevaluated cases to assess if appendix G, rev. 1, was implemented correctly
- Selection criteria:
  - assignment of external dose for the Operator and Laborer job category
  - employment during the period 1956–1959
  - occupational medical x-ray examinations with dose calculated using ORAUT-OTIB-0006, rev. 04, or later

Selection of PER-065 case review

- NIOSH identified one case that met all selection criteria
- NIOSH reworked the case
  - using applicable DR tools
  - recalculated all annual doses
  - re-ran IREP
- Rework of the case resulted in a POC less than 50%
- Formal revised DR report not sent to DOL because the compensation decision did not change

SC&A's review of reworked DR impacted by PER-065

- SC&A' review was generally limited to reevaluation of pathways addressed in PER-065
- External doses increased due to Anaconda site profile changes
- SC&A also assessed internal exposure to evaluate significant differences in NIOSH's original and reworked doses

PER-065 case background

- EE worked at Anaconda for three decades
- EE worked throughout site
- EE was not monitored for radiation exposure
- Diagnosed with qualifying cancer several years after employment termination

Comparison of NIOSH's reworked doses and original doses for PER-065 case

Dose categories	Reworked vs. original dose percentage
External	95% reduction
Occupational medical	261% increase
Internal	99.6% reduction
Total	71% reduction
POC	86% reduction

Original external dose calculations for PER-065 case

- Performed prior to issuance of TBD-6000, appendix G, using Scherpelz (2006)
- Assumed EE exposed 1 foot from a rectangular uranium slab for 3 days in 1956 and 30 days in 1959 for 10 work hours/day at 2.08 mrem/hour
- Bladder assumed as surrogate organ for photon DCF of 1.523
- Assigned external dose of >1.000 rem

Reworked external dose calculations for PER-065 case

- Used guidance in TBD-6000, appendix G, rev. 1
- Calculated external dose using annual photon doses for each year of uranium operations from table G.2
- Per ORAUT-OTIB-0005, rev. 05, liver assumed as surrogate organ for photon DCF of 1.064
- Assigned external dose of ~0.050 rem

Original medical dose calculations for PER-065 case

- Assumed annual x-ray for each year of employment
- Urinary bladder assumed as surrogate organ
- Used dose data from table 6-5 of OTIB-0006, rev. 03 PC-1
- Assigned external dose of ~0.1 rem

Reworked medical dose calculations for PER-065 case

- Assumed annual x-ray for each year of employment
- Gallbladder assumed as surrogate organ
- Used dose data from table 6-5 of OTIB-0006, rev. 04
- Assigned external dose of >0.3 rem

Original internal dose calculations for PER-065 case

- Uranium intakes assigned for extrusion (2,965 pCi/day) and rolling (10,559 pCi/day) in 1956 and 1959 using operator data from table 7.8 of Scherpelz (2006)
- Air sampling data derived from summary of AWE metal-working sites
- 30-day intake for each process applied for each year
- Intakes of recycled uranium components from plutonium-239 and neptium-237 were scaled from uranium intakes
- Using IMBA, type M solubility was claimant favorable
- Inhalation and ingestion intakes applied as inhalation
- Assigned internal dose of ~0.250 rem

Reworked internal dose calculations for PER-065 case

- Uranium intakes assigned based on inhalation and ingestion intakes from TBD-6000, appendix G, table G.1
- Inhalation values ranged, based on year of operation, from 0.66 to 3.74 dpm/day, as specified in table G.1
- Table G.1 ingestion value of 5.34 dpm/day used for all years
- Appendix G used highest reported air monitoring data (39 dpm/m^3) in work areas in 1956 and 1959
- Doses calculated for each year of uranium operations
- Using IMBA, type M solubility found to be claimant favorable
- Assigned internal dose of 0.001 rem

SC&A's conclusions on external dose for PER-065 case

- Reworked external dose:
  - Appropriate dose assigned based on appendix G, rev. 1
  - Surrogate organ based on current revision of ORAUT-OTIB-0005
  - Doses entered in IREP correctly
  - Note: If the original DR was performed using appendix G, rev. 0, the reworked external doses would have increased
- Reworked occupational medical dose:
  - Appropriate dose assigned based on OTIB-0006
  - Surrogate organ selection based on OTIB-0005
  - Doses entered in IREP correctly

SC&A's conclusions on internal dose for PER-065 case

- Reworked internal dose:
  - Appropriate intake values used as specified in appendix G, rev. 0
  - Input data entered in IMBA correctly
  - Assumptions claimant favorable
- SC&A had no findings about the selected reworked case impacted by PER-065

Board discussion of DCAS-PER-065

DCAS-PER-064, rev. 0

- Title: “DuPont Deep Water Works”
- Issued November 16, 2015
- Determines the effect of several changes to DuPont Deepwater Works DR methodology:
  - Original DRs used Battelle-TBD-6001, appendix B
  - Standalone document (DCAS-TKBS-0006; “TBD”) created 2/15/2011 after TBD-6001, appendix B, cancelled; some operational period doses increased, others decreased
  - TBD rev. 01 (12/13/2013) increased operational period inhalation intakes and external dose rates and residual period ingestion intakes
  - TBD rev. 02 (3/20/2015) increased ingestion intakes

SC&A's review of DCAS-PER-064, rev. 00

- SC&A separately reviewed DuPont Deepwater TBD
- PER-064 review consisted of only subtask 4 protocol for evaluation of a sample set of impacted cases
- SC&A reviewed two cases under its subtask 4 protocol:
  - One case resulting in a POC between 45% and 50%
  - One case with external and internal dose assignments during the operational and residual periods
- SC&A submitted its subtask 4 report December 12, 2016
- No findings identified
- Presented case review to SCPR October 31, 2018

PER-064 case 1 background

- EE worked at DuPont Deepwater Works for three decades
- EE worked throughout site
- EE was not monitored for radiation exposure
- Diagnosed with two qualifying cancers several years after employment termination

Comparison of NIOSH's reworked doses and original doses for PER-064 case 1

Dose categories [a]	Reworked vs. original dose percentage for cancer 1	Reworked vs. original dose percentage for cancer 2
External	52% decrease	43% decrease
Occupational medical	14% increase	14% increase
Internal	1% increase	04% increase
Total [b]	34% decrease	12% decrease

[a] SC&A's review only evaluated external and internal doses, as addressed in PER-064.
[b] Reworked vs. original combined POC increased by 30%.

Original external dose calculations for PER-064 case 1

- Assumed a job category of “Plant Floor Low”
- Operational doses assigned using values in table B.3 of TBD-6001, appendix B, rev. 0
- Operational dose for 1942 = 642 mR/yr; 1943–1948 = 1,161 mR/yr
- Appendix B, table B.3, annual dose of 0.040 R assigned during residual period
- Applicable OCAS-IG-001, rev. 3, anterior-posterior (AP) geometry exposure-to-organ DCF values applied
- Assigned dose of ~3.0 rem to cancer 1 and ~5.0 rem to cancer 2
- Annual doses were entered in IREP as constant values

Reworked external dose calculations for PER-064 case 1

- Operational doses:
  - Assumed job category of “Laborers”
  - Used value (672 mR/yr) in table 7 of the DuPont Deepwater TBD, rev. 02
  - Photon energy ranges 50% 30–250 keV and 50% >250 keV
  - Applied IG-001, rev. 3, AP geometry, exposure-to-organ DCF values
  - Entered in IREP as lognormal with geometric standard deviation (GSD) of 5
- Residual doses:
  - Assigned TBD table 8 annual dose of 7.3 mR for all workers
  - Photon energy range 100% 30–250 keV
  - Applied IG-001, rev. 3, AP geometry, exposure-to-organ DCF value
  - Entered in IREP as constant
- Assigned dose of ~2.0 rem to cancer 1 and ~1.5 rem to cancer 2

SC&A's conclusions on the reworked external doses for PER-064 case 1

- SC&A was able to match operational external doses:
  - Using Laborer doses from table 7, DuPont Deepwater TBD, rev. 02
  - Applying appropriate IG-001 exposure-to-organ DCF values
  - Assigning doses to 50% 30–250 keV and 50% >250 keV
- SC&A was able to match residual external doses:
  - Using doses from table 8 of DuPont Deepwater TBD, rev. 02
  - Applying appropriate IG-001 exposure-to-organ DCF values
  - Assigning doses to 100% 30–250 keV
- SC&A verified all annual doses were entered in IREP as specified in guidance
- No findings

Original internal dose calculations for PER-064 case 1

- Operational intakes for inhalation (1,428 dpm/day) and ingestion (25 dpm/day) from TBD-6001, appendix B, table B.1
- Residual period intakes for inhalation (0.329 dpm/day) and ingestion (0.00385 dpm/day) from TBD-6001, appendix B, table B.2
- Type F solubility uranium-234 assumed
- Assigned dose of ~2.0 rem to cancer 1 and ~7.0 rem to cancer 2
- Annual doses entered in IREP as constant

Reworked internal dose calculations for PER-064 case 1

- Assumed job category of “Supervisors/Laborer”
- Operational intakes for inhalation (1,428 dpm/day) and ingestion (27 dpm/day) from DCAS-TKBS-0006, table 1
- Residual period intakes for inhalation (0.329 dpm/day) and ingestion (30.1 dpm/day) from TBD table 10
- Compared types F, M, and S uranium-234 for operational period with type F solubility most claimant favorable
- Compared types M and S uranium-234 for residual period with type M solubility most claimant favorable
- Total assigned dose of ~2.0 rem to cancer 1 and ~7.0 rem to cancer 2
- Annual doses entered in IREP as constant

SC&A's conclusions on the reworked internal doses for PER-064 case 1

- SC&A' assessment of internal doses:
  - Ran IMBA using inhalation and ingestion intake values specified in DCAS-TKBS-0006, rev. 02
  - Compared solubility types F, M, and S for the operational period and verified type F was most claimant favorable
  - Compared types M and S for the residual period and verified type M was claimant favorable
  - Found that annual doses were entered in IREP correctly and in accordance with TBD guidance
- SC&A re-ran IREP using the reworked external and internal doses and was able to derive a POC that approximated NIOSH's POC
- Note: Doses decreased but POC increased, primarily due to entering operational dose in IREP as lognormal with a GSD of 5

PER-064 case 2 background

- EE worked at DuPont Deepwater Works for three decades
- EE was not monitored for radiation exposure
- Diagnosed with one qualifying cancer several years after employment termination

Comparison of NIOSH's reworked doses and original doses for PER-064 case 2

Dose categories	Reworked vs. original dose percentage
External	51% decrease
Occupational medical	14% increase
Internal	0.03% increase
Total	10% decrease
POC	16% increase

Original external dose calculations for PER-064 case 2

- Assumed a job category of “Plant Floor High”
- Operational doses assigned using values in table B.3 of TBD-6001, appendix B, rev. 0
- Operational dose for 1942 = 642 mR/yr; 1943–1948 = 1,161 mR/yr
- Appendix B, table B.3, annual dose of 0.040 R assigned during residual period
- Applied IG-001, rev. 3, AP geometry exposure-to-organ DCF value for bladder, as surrogate organ
- Assigned dose of ~10.0 rem
- Annual doses were entered in IREP as constant values

Reworked external dose calculations for PER-064 case 2

- Operational doses:
  - Assumed job category of “Operators”
  - Used value (672 mR/yr) in table 7 of the DuPont Deepwater TBD, rev. 02
  - Photon energy ranges 50% 30–250 keV and 50% >250 keV
  - Applied IG-001, rev. 3, AP geometry, exposure-to-organ DCF value for bladder as surrogate organ
  - Entered in IREP as lognormal with GSD of 5
- Residual doses:
  - Assigned TBD table 8 annual dose of 7.3 mR for all workers
  - Photon energy range 100% 30–250 keV
  - Applied IG-001, rev. 3, AP geometry, exposure-to-organ DCF value for bladder as surrogate organ
  - Entered in IREP as constant
- Assigned dose of ~5.0 rem

SC&A's conclusions on the reworked external doses for PER-064 case 2

- SC&A was able to match operational external doses:
  - Using Operators dose from table 7, DuPont Deepwater TBD, rev. 02
  - Applying appropriate IG-001 exposure-to-organ DCF values
  - Assigning doses to 50% 30–250 keV and 50% >250 keV
- SC&A was able to match residual external doses:
  - Using dose from table 8 of DuPont Deepwater TBD, rev. 02
  - Applying appropriate IG-001 exposure-to-organ DCF values
  - Assigning doses to 100% 30–250 keV
- SC&A confirmed all annual doses entered in IREP as specified in guidance
- No findings

Original internal dose calculations for PER-064 case 2

- Operational intakes for inhalation (1,428 dpm/day) and ingestion (25 dpm/day) from TBD-6001, appendix B, table B.1
- Residual period intakes for inhalation (0.329 dpm/day) and ingestion (0.00385 dpm/day) from TBD-6001, appendix B, table B.2
- Type F solubility uranium-234 assumed
- Assigned dose of ~46.0 rem
- Annual doses entered in IREP as constant

Reworked internal dose calculations for PER-064 case 2

- Assumed job category of “Operators”
- Operational intakes for inhalation (25,245 dpm/day) and ingestion (478 dpm/day) from DCAS-TKBS-0006, table 1
- Residual period intakes for inhalation (0.329 dpm/day) and ingestion (30.1 dpm/day) from TBD table 10
- Compared types F, M, and S uranium-234 for operational period, with type F solubility most claimant favorable
- Compared types M and S uranium-234 for residual period, with type M solubility most claimant favorable
- Total assigned dose of ~46.0 rem
- Annual doses entered in IREP as constant

SC&A's conclusions on the reworked internal doses for PER-064 case 2

- SC&A's assessment of internal doses:
  - Ran IMBA using inhalation and ingestion intake values specified in DCAS-TKBS-0006, rev. 02
  - Compared solubility types F, M, and S for the operational period and verified type F was most claimant favorable
  - Compared types M and S for the residual period and verified type M was claimant favorable
  - Found that annual doses were entered in IREP correctly and in accordance with TBD guidance
- SC&A re-ran IREP using the reworked external and internal doses and was able to derive a POC that approximated NIOSH's POC
- Note: Doses decreased but POC increased, primarily due to entering operational dose in IREP as lognormal with a GSD of 5

Board discussion of DCAS-PER-064

Reference

- Scherpelz, R. I. (2006). *Site profiles for Atomic Weapons Employers that worked uranium and thorium metals* (PNWD-3738, rev. 0). Pacific Northwest Division, Battelle, Richland, WA.