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

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Advisory Board on Radiation and Worker Health

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SCPR-approved documents

- DCAS-PER-049, rev. 0, “Paducah Gaseous Diffusion Plant”
- OCAS-PER-008, rev. 0, “Modification of NIOSH-IREP Lung Cancer Risk Model: Effect of ‘Combined’ Lung Model on Non-compensable Lung Cancer Claims”
- OCAS-PER-006, rev. 0, “External Dosimetry Target Organ for Prostate Cancer”
- ORAUT-OTIB-0023, rev. 00, “Assignment of Missed Neutron Doses Based on Dosimeter Records”
- DCAS-PER-066, rev. 0, “Huntington Pilot Plant”

DCAS-PER-049, rev. 0

- Title: “Paducah Gaseous Diffusion Plant”
- Issued August 5, 2016
- Determines the effect of several revisions to the Paducah technical basis document (TBD)
- Doses increased due to revisions in TBD sections:
  - Section 3: Occupational medical x-ray exam frequency default increased in rev. 03, August 23, 2012
  - Section 4: Occupational environmental external doses increased for some assigned years in rev. 03, August 24, 2012
  - Section 6: Occupational external dose increased due to assigned dose from neutrons and inclusion of Tc-99 in rev. 04, August 24, 2012

SC&A's review of PER-049, rev. 0

- Paducah TBD reviewed separately
- SC&A identified 25 findings that were resolved under the work group (WG) on K-25, Paducah, and Portsmouth gaseous diffusion plants
- PER-049 review consisted of only subtask 4 protocol for evaluation of a sample set of impacted cases

Subtask 4 case selection

- Case selected based on criteria:
  - Nonsmoker with site default x-ray frequency assigned between 1951 and 1973
  - External environmental dose assigned for some years
  - Increase in neutron dose assigned
  - Tc-99 external dose assigned
- Cases were selected from six cases where the rework resulted in a POC between 45% and 50%
- Among the six cases, none had external environmental dose or Tc-99 external dose assigned

SC&A's subtask 4 review of PER-049, rev. 0

- SC&A reviewed one case
  - Energy employee (EE) was assigned site default occupational x-rays
  - EE was assigned neutron dose
- Review limited to assessing only those methods that relate to issues addressed in PER-049
- SC&A submitted its subtask 4 report March 2, 2018
- No findings
- SC&A presented its review to the SCPR at the October 31, 2018, meeting

PER-049 case background

- EE worked at Paducah for ~1 decade
- Worked throughout the facility
- Monitored for external and internal radiation exposure
- Diagnosed with qualifying cancer ~4 decades after termination of employment

Comparison of NIOSH's reworked doses and original doses for PER-049 case

Dose categories	Reworked vs. original dose percentage
External	9% decrease
Occupational medical	84% decrease
Internal	81% increase
Total	24% increase
POC	15% increase

Original occupational medical dose calculation for PER-049 case

- Used default x-ray exams and frequency recommendations from Paducah TBD-3, rev. 00
- Assigned dose as specified in Paducah TBD-3, rev. 00
- Total dose ~3.5 rem

Reworked occupational medical dose calculation for PER-049 case

- Frequency of exams based on DOE records
- Also assumed pre-employment exam
- Assigned dose as specified in Paducah TBD-3, rev. 03
- Total dose ~0.5 rem
- Note: Although exam frequency increased, the lumbar spine dose decreased from 2,900 mrem to 347 mrem

SC&A's review of reworked occupational medical dose calculations

- Identified eight posterior-anterior x-rays and a lumbar spine exam in DOE records
- Pre-employment exam included in accordance with TBD-3 rev. 03 guidance
- Assigned dose based on tables 3-3 and 3-4 of Paducah TBD-3, rev. 03
- Verified total dose ~0.5 rem
- Doses appropriately entered in IREP as normal distributions with 30% uncertainty

Original neutron dose for PER-049 case

- Neutron dose not considered
- Paducah TBD-6, rev. 00, did not recommend assignment of neutron dose based on job title and work location

Reworked neutron dose calculation for PER-049 case

- Neutron dose calculated based on guidance of TBD-6, rev. 04:
  - neutron-to-photon ratio value of 0.2 applied to measured, missed, and unmonitored photon doses
  - International Commission on Radiological Protection adjustment factor of 2.0
  - energy range of 0.1 to 2 MeV
- Applied OCAS-IG-001 dose conversion factor (DCF) values
- Assigned total neutron dose of ~4 rem

SC&A's review of reworked neutron dose calculations for PER-049 case

- Confirmed that neutron dose calculations were based on guidance of TBD-6, rev. 04
- Verified that appropriate IG-001 DCF values were applied
- Recalculated measured, missed, and unmonitored neutron doses
- Total assigned neutron dose was correctly calculated
- Annual doses entered in IREP appropriately

Environmental and Tc-99 doses

- Neither original nor reworked DRs considered external environmental dose because measured, missed, and unmonitored dose were assigned
- Neither original nor reworked DRs considered dose from exposure to Tc-99 because organ of interest would not be impacted by nonpenetrating dose
- SC&A concurs with NIOSH's conclusions on environmental and Tc-99 doses

Internal dose calculations for PER-049

- SC&A did not verify the accuracy of internal dose, because it was not impacted by PER-049
- SC&A noted that the significant increase in internal dose was based on:
  - Original DR used hypothetical intakes
  - Reworked DR used EE's bioassay data

Board discussion of DCAS-PER-049

OCAS-PER-008, rev. 0

- Title: “Modification of NIOSH-IREP Lung Cancer Risk Model: Effect of ‘Combined’ Lung Model on Non-compensable Lung Cancer Claims”
- Issued April 12, 2007
- Determines the impact of NIOSH-IREP 5.5 issued February 28, 2006, followed by version 5.5.1 issued May 16, 2006
- IREP revision:
  - compares POCs calculated using NIOSH-IREP and NIH-IREP for lung, trachea, or bronchus cancers and reports the higher
  - incorporates a bias correction factor for random errors in dosimetry for “never smoker” exposed to radon

SC&A's review of PER-008, rev. 0

- PER-008 review submitted December 15, 2010
- Identified two findings
- SC&A presented review to the SCPR at the March 22, 2011, meeting
- SCPR determined subtask 4 case review was not necessary, because only IREP was re-run and no DRs were reworked

Board discussion of OCAS-PER-008

OCAS-PER-006, rev. 0

- Title: “External Dosimetry Target Organ for Prostate Cancer”
- Issued September 15, 2006
- Assesses the impact of changing external dosimetry target organ for prostate cancer from testes to bladder
  - Dosimeter external doses decreased due to bladder DCF < testes DCF
  - Occupational medical surrogate organ dose increased slightly, but offset by measured, missed, and unmonitored external doses
- No cases reevaluated because dose and POC will not increase

SC&A's review of PER-006, rev. 0

- Review submitted October 29, 2007
- Concurs that bladder is more appropriate surrogate organ:
  - Bladder deep in the body cavity
  - Bladder close to prostate
  - Testes significantly overestimates external beta and low-energy photons since close to body surface
- SC&A had one administrative finding

Board discussion of OCAS-PER-006

ORAUT-OTIB-0023, rev. 00

- Title: “Assignment of Missed Neutron Doses Based on Dosimeter Record”
- Provides guidance to determine when it is appropriate to assign neutron doses to EEs at DOE sites using the half limit of detection (LOD/2) method
- Revision 00 issued March 7, 2005
- Revision 01 issued May 14, 2008

OTIB-0023, rev. 00, guidance

- When neutrons were monitored using reliable dosimeters and results are zero, the LOD/2 method is appropriate
- Missed neutron dose is not assigned if both of the following conditions are met:
  1. Neutron missed dose estimate (nLOD/2) exceeds 75% of measured and missed photon dose
  2. Based on work location and site-specific data, it is determined EE neutron dose was zero or incidental relative to assigned external dose

SC&A's review of OTIB-0023, rev. 00

- Review submitted June 8, 2006
- Review identified eight findings
- Findings discussed and resolved during many SCPR meetings in 2007 and 2008

Board discussion of ORAUT-OTIB-0023

DCAS-PER-066, rev. 0

- Title: “Huntington Pilot Plant”
- Issued November 30, 2015
- Determines the effect of rev. 01 of the Huntington Pilot Plant TBD, DCAS-TKBS-0004, issued December 12, 2013
- Revision added intakes for Am-241, Th-230, and Tc-99 for the periods 1956–1963 and 1978–1979, which increased internal dose estimates for all claims

History of Huntington Pilot Plant TBD

- ORAUT-TKBS-0004, “Technical Basis Document: Basis for Development of an Exposure Matrix for Huntington Pilot Plant,” rev. 00 (October 2003)
- ORAUT-TKBS-0004, “Technical Basis Document: Basis for Development of an Exposure Matrix for Huntington Pilot Plant,” rev. 01 (January 2004)
- OCAS-PER-025 (September 2007) evaluated addition of electron dose in revision 01
- OCAS-TKBS-0004, “Technical Basis Document for the Huntington Pilot Plant, Huntington, West Virginia,” rev. 00 (August 2008), added intakes for total uranium, Pu-239, and Np-237
- DCAS-PER-033 (December 2011) evaluated increase in internal dose

SC&A's review of PER-066, rev. 0

- SC&A's previous reviews included:
  - OCAS-TKBS-0004, rev. 00 (focused review under Subcommittee for Dose Reconstruction Reviews) (reviewed March 2013)
  - OCAS-PER-025, rev. 0 (reviewed July 2013)
  - OCAS-TKBS-0004, rev. 00 (reviewed June 2013)
  - OCAS-PER-033, rev. 0 (reviewed July 2013)
- PER-066 review consisted of only a sample set of impacted cases (Subtask 4)
- SC&A submitted its subtask 4 report October 11, 2016
- SC&A identified one finding
- Review presented to SCPR at the October 31, 2018, meeting

PER-066 subtask 4 case selection and review process

- NIOSH identified two reworked cases with POCs between 45% and 50%; these cases were selected for review
- Review was limited to evaluating only those methods and corrective actions that relate to issues addressed in PER-066
- SC&A's review evaluated only internal dose calculations

Huntington Pilot Plant history

- Alternative name: Reduction Pilot Plant
- Covered period: 1951–1963, 1978–1979
- Supplied nickel powder used to make gaseous diffusion barrier for Paducah and Portsmouth gaseous diffusion plants
- Sources of feed material were nickel oxide and barrier scrap contaminated with uranium and associated radionuclides from the uranium enrichment process

PER-066 case 1 background

- EE worked at Huntington Pilot Plant for many years
- No records of external or internal monitoring available
- EE classified as a plant worker
- Diagnosed with a qualifying cancer after termination of employment

Comparison of NIOSH's reworked doses and original doses for PER-066 case 1

Dose categories	Reworked vs. original dose percentage
External	~69% decrease
Occupational medical	~3% decrease
Internal	>40,000% increase
Total	~202% increase
POC	~47% increase

Original internal dose calculations for PER-066 case 1

- DR performed in 2003
- Used internal intake values from table 5 of ORAUT-TKBS-0004, rev. 00
- Calculated doses using CADW for total uranium, Pu-239, and Np-237
- Resulted in assigning a total dose of >0.100 rem

Reworked internal dose calculations for PER-066 case 1

- Used appropriate inhalation and ingestion intake values from table 5 of DCAS-TKBS-0004, rev. 01
- Calculated doses using CADW for total uranium, Pu-239, Np-237, Am-241, Th-230, and Tc-99
- Compared absorption types as specified in table 5
- Doses entered in IREP as constant values
- Resulted in assigning a total dose of nearly 9.0 rem

SC&A's conclusions about internal dose calculations for PER-066 case 1

- Concurs that EE should be classified as a plant worker
- Verified correct inhalation and ingestion intake values from table 5 of DCAS-TKBS-0004, rev. 01
- Confirmed the greater dose was assigned considering the potential solubility types
- Re-ran CADW used rev. 01 TBD-specified values
- Entered annual doses in IREP
- Calculated a POC that approximated NIOSH's POC
- No findings about rework of case 1

PER-066 case 2 background

- EE worked at Huntington Pilot Plant for many years
- No records of external or internal monitoring available
- EE classified as a plant worker
- Diagnosed with qualifying cancers several years after termination of employment

Comparison of NIOSH's reworked doses and original doses for PER-066 case 2

Dose categories	Cancer 1 reworked vs. original dose percentage	Cancer 2 reworked vs. original dose percentage
External	~72% decrease	~72% decrease
Occupational medical	~37% decrease	~37% decrease
Internal	~718% increase	~721% increase
Total	~263% increase	~272% increase
POC	~25% increase	~9% increase

Original internal dose calculations for PER-066 case 2

- DR performed in 2004
- Used internal intake values from table 5 of DCAS-TKBS-0004, rev. 01
- Calculated doses using CADW for total uranium, Pu-239, and Np-237
- Resulted in assigning a total dose of ~6.000 rem for both cancers

Reworked internal dose calculations for PER-066 case 2

- Used appropriate inhalation and ingestion intake values from table 5 of DCAS-TKBS-0004, rev. 01
- Calculated doses using CADW for total uranium, Pu-239, Np-237, Am-241, Th-230, and Tc-99
- Compared absorption types as specified in table 5
- Doses entered in IREP as constant values
- Resulted in assigning a total dose of >22.0 rem for cancer 1 and >23.0 rem for cancer 2

SC&A's conclusions about internal dose calculations for PER-066 case 2

- Concurs that EE should be classified as a plant worker
- Verified correct inhalation and ingestion intake values from table 5 of DCAS-TKBS-0004, rev. 01
- Confirmed the greater dose was assigned considering the potential solubility types
- Re-ran CADW used rev. 01 TBD-specified values
- Using IREP, SC&A calculated a POC that approximated NIOSH's POC
- No findings about the rework of case 2
- SC&A did have one finding about TBD rev. 01

Issue resolution for PER-066 subtask 4, finding 1

Finding date	Finding description	NIOSH followup	Finding resolution
6/8/2006	TKBS-0004, rev. 01, table 5, has errors associated with inhalation and ingestion for Administrative Workers: • Th-230 ingestion intake value of 6.3E-1 pCi/day is incorrect; the correct value is 1.7E-3 pCi/day • Tc-99 inhalation intake value of 1.9E-1 pCi/day is incorrect; the correct value is 5.2E-4 pCi/day • Tc-99 ingestion intake value of 4.0E-3 pCi/day is incorrect; the correct value is 1.1E-5 pCi/day	**10/31/2018.** NIOSH acknowledged that there were errors in these three entries in table 5. They are in the process of revising the TBD to correct those values.	**10/31/2018.** SCPR closed the finding but requested that the BRS be updated when the TBD was revised. NIOSH revised the TBD November 5, 2018, and table 5 values were corrected.

Board discussion of DCAS-PER-066