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ADVISORY BOARD ON
RADIATION AND WORKER HEALTH

National Institute for Occupational Safety and Health

DCAS-PER-066, SUBTASK 4

REVIEW OF IMPACTED CASES REWORKED FOR THE EVALUATION OF INTERNAL INTAKES FROM THE HUNTINGTON PILOT PLANT

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ABBREVIATIONS AND ACRONYMS

Advisory Board	Advisory Board on Radiation and Worker Health
Am	americium
CADW	chronic annual dose workbook
CATI	computer-assisted telephone interview
DCAS	Division of Compensation Analysis and Support
DR	dose reconstruction
EE	energy employee
HPP	Huntington Pilot Plant
ICD	International Classification of Diseases
IREP	Interactive RadioEpidemiological Program
NIOSH	National Institute for Occupational Safety and Health
Np	neptunium
OCAS	Office of Compensation Analysis and Support
ORAU	Oak Ridge Associated Universities
ORAUT	Oak Ridge Associated Universities Team
OTIB	ORAUT technical information bulletin
pCi/day	picocuries per day
pCi/yr	picocuries per year
PER	program evaluation report
POC	probability of causation
PRSC	Procedures Review Subcommittee
Pu	plutonium
TBD	technical basis document
Tc	technetium
Th	thorium
TIB	technical information bulletin

1.0 RELEVANT BACKGROUND INFORMATION

On May 16, 2016, the Procedures Review Subcommittee (PRSC) of the Advisory Board on Radiation and Worker Health (Advisory Board) tasked SC&A, Inc. to conduct a Subtask 4 (i.e., review of a sample set of impacted cases) review of DCAS-PER-066, *Huntington Pilot Plant Program Evaluation Report* (DCAS 2015). The terms "Huntington Pilot Plant" and "Reduction Pilot Plant" are often used interchangeably; Huntington Pilot Plant (HPP) will be used in this report. The National Institute for Occupational Safety and Health (NIOSH) issued DCAS-PER-066 to determine the number of claims affected by the revisions to the HPP technical basis document (TBD) made in DCAS-TKBS-0004, *Technical Basis Document for the Huntington Pilot Plant, Huntington, West Virginia*, Revision 01 (DCAS 2013). This revised TBD added internal intake values for americium-241 (Am-241), thorium-230 (Th-230), and technetium-99 (Tc-99) for the periods 1956–1963 and 1978–1979. These changes could increase internal dose assignments in some previous dose reconstructions (DRs), as stated in Section 2.0 of DCAS-PER-066:

> *Revision 1 of DCAS-TKBS-0004 added intakes for Am-241, Th-230 and Tc-99. That results in an increased internal dose estimate for all claims that were completed using an earlier version. Therefore, it was not necessary to itemize any other increases in dose or further breakdown the time periods affected.*

The previous TBDs—ORAUT-TKBS-0004, *Technical Basis Document: Basis for Development of an Exposure Matrix for Huntington Pilot Plant*, Revision 00 (ORAUT 2003); ORAUT-TKBS-0004, *Technical Basis Document: Basis for Development of an Exposure Matrix for Huntington Pilot Plant*, Revision 01 (ORAUT 2004); and OCAS-TKBS-0004, *Technical Basis Document for the Huntington Pilot Plant, Huntington, West Virginia*, Revision 00 (OCAS 2008)—provided recommended intakes for total uranium, plutonium-239 (Pu-239), and neptunium-237 (Np-237), but not for Am-241, Th-230, and Tc-99.

In conducting a review of a program evaluation report (PER), SC&A is typically committed to perform five subtasks, as specified below (SC&A 2009):

Subtask 1. Assess NIOSH's evaluation/characterization of the "issue" and its potential impacts on DR. SC&A's 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 documents (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 reevaluation. This third step may have important implications in instances where the universe of previously denied DRs is very large and, for reasons of practicality, NIOSH's reevaluation is confined to a subset of DRs that, based on their scientific judgment, have the potential to be significantly affected by the PER. In behalf of Subtask 3, SC&A will also evaluate the timeliness for the completion of the PER.

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

Subtask 5. Prepare a comprehensive written report that contains the results of the above subtasks, along with SC&A's review conclusions.

Because SC&A has reviewed all previous HPP TBDs and NIOSH has committed to review all HPP DRs that previously had a probability of causation (POC) less than 50%, as stated in Section 3.0 of DCAS-PER-066, the PRSC determined that SC&A did not need to perform Subtasks 1, 2, and 3. Therefore, this report fulfills the requirement defined in Subtask 4, "Conduct audits of DRs affected by the PER under review."

In Section 3.0 of DCAS-PER-066, NIOSH identified two reworked cases that had POCs between 45% and 50%. These cases were selected for review under Subtask 4 and provided to SC&A on May 18, 2016. Based on the PRSC's guidance, SC&A's review of these cases is limited to evaluating only those methods and corrective actions introduced in the reevaluated dose that relate strictly to issues addressed in DCAS-PER-066. Sections 2 and 3 below present SC&A's focused review to determine whether the internal doses associated with the two selected cases were correctly assigned per the recommendations in DCAS-PER-066.

1.1 FINDING 1: INCORRECT VALUES CITED IN DCAS-TKBS-0004, TABLE 5

In reviewing the two cases, SC&A used Tables 4 and 5 of DCAS-TKBS-0004 (DCAS 2013) and found that Table 5, with units of picocuries per day (pCi/day), had several errors in the **Administrative Workers'** section (the Production Workers' section was correct). The errors were as follows:

- **Th-230 Ingestion –** Table 5 lists an ingestion intake value of 6.3E-1 pCi/**day**, which is the same numerical value listed in Table 4 as 6.3E-1 picocuries per year (pCi/**yr)**. The value of 6.3E-1 pCi/yr in Table 4 should have been divided by 365 day/yr to obtain the correct value of 1.7E-3 pCi/day for Table 5.

- **Tc-99 Inhalation –** Table 5 lists an inhalation intake value of 1.9E-1 pCi/**day**, which is the same numerical value listed in Table 4 as 1.9E-1 pCi/**yr**. The value of 1.9E-1 pCi/yr in Table 4 should have been divided by 365 day/yr to obtain the correct value of 5.2E-4 pCi/day for Table 5.

- **Tc-99 Ingestion –** Table 5 lists an ingestion intake value of 4.0E-3 pCi/**day**, which is the same numerical value listed in Table 4 as 4.0E-3 pCi/**yr**. The value of 4.0E-3 pCi/yr in Table 4 should have been divided by 365 day/yr to obtain the correct value of 1.1E-5 pCi/day for Table 5.

These errors would result in a slight overestimate of internal doses but did not impact the dose or POC determinations for the two cases reviewed, because the two EEs were production workers, not administrative workers.

2.0 REVIEW OF DCAS-PER-066 ISSUE FOR CASE # [redacted] (HPP)

2.1 BACKGROUND INFORMATION FOR THIS CASE

Case # [redacted] represents an energy employee (EE) who worked at HPP from [redacted] 1952, through [redacted] 1982. During this worker's employment, the EE worked as a **Maintenance Worker** in the [redacted] according to the computer-assisted telephone interview (CATI). The EE was diagnosed with [redacted] **cancer** (International Classification of Diseases [ICD] Code [redacted]) in December 2000. No records of external or internal monitoring were available for this EE; therefore, external doses and internal intakes and doses were assigned according to the HPP TBD (DCAS 2013). Production Worker values recommended in TBD Table 6 were used for external doses, and Production Worker values in Table 5 were used in determining internal intakes and doses. ORAUT-OTIB-0006, *Technical Information Bulletin: Dose Reconstruction from Occupationally Related Diagnostic X-ray Procedures*, Revision 04 (NIOSH 2011), was used for assigning medical x-ray doses.

2.2 COMPARISON OF NIOSH'S ORIGINAL AND REWORKED DOSE RECONSTRUCTIONS

NIOSH performed the original DR of Case # [redacted] in February 2003. The claim was reworked in September 2015, as per DCAS-PER-066. Table 1 summarizes the results for this case as reworked by NIOSH.

Table 1. Original and Reworked Results for Case # [redacted]

Dose Type	Original Dose (rem)	Rework as per DCAS-PER-066 (rem)
External	2.330	0.724
Medical X-ray	1.210	1.173
Internal	0.022	8.885
Total Dose	3.562	10.782
POC	33.94%	49.87%

Revisions in the HPP TBD (DCAS 2013) after the original DR was performed resulted in decreases in some of the external doses and medical x-ray doses for the reworked case in 2015. The application of DCAS-PER-066 resulted in an increase in internal dose, with an overall increase in the resulting POC. SC&A was tasked with only evaluating the application of DCAS-PER-066 to this case (addition of Am-241, Th-230, and Tc-99 intakes and doses); therefore, SC&A did not review the other aspects of the DR rework.

2.3 SC&A'S REVIEW OF DCAS-PER-066 ISSUE RELATED TO THIS CASE

As directed by the PRSC, SC&A's review of Case # [redacted] focused on revised internal dose, as specified by the criteria in DCAS-PER-066. Case # [redacted] required the internal doses to be reworked because the EE worked at HPP during the periods [redacted] and [redacted].

2.3.1 Original Dose Reconstruction

The original DR, performed in 2003, assigned internal intakes using the recommended intake values from Table 5, page 8, of ORAUT 2003 in the chronic annual workbook (CADW) and entered the resulting doses in the Interactive RadioEpidemiological Program (IREP) Input table. The radionuclide intake values given in the Table 5 of ORAUT 2003 were for total uranium, Pu-239, and Np-237.

2.3.2 Reworked Dose Reconstruction

In the reworked DR performed in 2015, NIOSH used the recommended internal intake values from Table 5, page 17, of DCAS 2013 (which included Am-241, Th-230, and Tc-99) in the CADW and entered the resulting doses in the IREP Input table. The new IREP Input table (which contained other revised doses according to DCAS 2013 recommendations) was used to determine the revised POC.

2.3.3 SC&A's Evaluation

SC&A ran the appropriate CADW using the intake values for total uranium, Pu-239, and Np-237 plus the additional intake values for Am-241, Th-230, and Tc-99. SC&A then evaluated the recent dose rework and concurs that NIOSH used the correct intake values and assigned the greater dose considering the potential solubility types (Type M and Type S). The resulting dose values were entered correctly in the IREP Input table (along with other revised dose values according to DCAS-PER-066). SC&A calculated the POC using the IREP Input table and derived approximately the same POC value as NIOSH did for the reworked case. (SC&A found that the NIOSH-IREP v.5.8 on the website will not run IREPs with random seed generators; therefore, SC&A used a random seed of 99 to run the program and obtain similar POC values.) SC&A had no findings concerning this case in view of DCAS-PER-066.

3.0 REVIEW OF DCAS-PER-066 ISSUE FOR CASE # [redacted] (HPP)

3.1 BACKGROUND INFORMATION FOR THIS CASE

Case # [redacted] represents an EE who worked at HPP from [redacted] 1951, through [redacted] 1968. During this worker's employment, the EE worked as an **Operator** according to the CATI. The EE was diagnosed with [redacted] **cancer** (ICD Code [redacted]) in March 1975 and recurrent [redacted] **cancer** (ICD Code [redacted]) in May 1985. No records of external or internal monitoring were available for this EE; therefore, external doses and internal intakes and doses were assigned according to the HPP TBD (DCAS 2013). Production Worker values recommended in TBD (DCAS 2013) Table 6 were used for external doses, and Production Worker values in Table 5 were used in determining internal intakes and doses. ORAUT-OTIB-0006 (NIOSH 2011) was used for assigning medical x-ray doses.

3.2 COMPARISON OF NIOSH'S ORIGINAL AND REWORKED DOSE RECONSTRUCTIONS

NIOSH performed the original DR of Case # [redacted] in February 2004. The claim was reworked in September 2015, as per DCAS-PER-066. Table 2 summarizes the results for this case as reworked by NIOSH.

Table 2. Original and Reworked Results for Case # [redacted]

Dose Type	[redacted] 1975 Original Dose (rem)	[redacted] 1975 Rework as per DCAS-PER-066 (rem)	[redacted] 1985 Original Dose (rem)	[redacted] 1985 Rework as per DCAS-PER-066 (rem)
External	1.962	0.552	1.962	0.552
Medical X-ray	1.729	1.089	1.729	1.089
Internal	2.588	21.171	2.693	22.110
Total Dose	6.278	22.812	6.384	23.751
POC	24.38%	30.39%	26.64%	28.93%

The original DR's combined POC was 29.79%; the reworked DR's combined POC was 47.86%.

Revisions in the HPP TBD (DCAS 2013) after the original DR was performed resulted in decreases in some of the external doses and medical x-ray doses for the reworked case in 2015. The application of DCAS-PER-066 resulted in an increase in internal dose, with an overall increase in the resulting POC. SC&A was tasked with only evaluating the application of DCAS-PER-066 to this case (addition of Am-241, Th-230, and Tc-99 intakes and doses); therefore, SC&A did not review the other aspects of the DR rework.

3.3 SC&A'S REVIEW OF DCAS-PER-066 ISSUE RELATED TO THIS CASE

As directed by the PRSC, SC&A's review of Case # [redacted] focused on revised internal dose, as specified by the criteria in DCAS-PER-066. Case # [redacted] required the internal doses to be reworked because the EE worked at HPP during the period [redacted].

3.3.1 Original Dose Reconstruction

The original DR, performed in 2004, assigned internal intakes using the recommended intake values from Table 5, page 8, of ORAUT 2004 in the CADW and entered the resulting doses in the IREP Input table. The radionuclide intake values provided in Table 5 of ORAUT 2004 were for total uranium, Pu-239, and Np-237.

3.3.2 Reworked Dose Reconstruction

In the reworked DR performed in 2015, NIOSH used the recommended internal intake values from Table 5, page 17, of DCAS 2013 (which included Am-241, Th-230, and Tc-99) in the CADW and entered the resulting doses in the IREP Input tables. The new IREP Input tables (which contained other revised doses according to DCAS 2013 recommendations) were used to determine the revised POC.

3.3.3 SC&A's Evaluation

SC&A ran the appropriate CADWs using the intake values for total uranium, Pu-239, and Np-237 plus the additional intakes values for Am-241, Th-230, and Tc-99. SC&A then evaluated the recent dose rework and concurs that NIOSH used the correct intake values and assigned the greater dose considering the potential solubility types (Type M and Type S). The resulting dose values were entered correctly in the IREP Input tables (along with other revised dose values according to DCAS-PER-066). SC&A calculated the POCs using IREP Input tables and derived the same POC values and combined POC. (SC&A found that the NIOSH-IREP v.5.8 on the website will not run IREPs with random seed generators; therefore, SC&A used a random seed of 99 to run the program and obtain similar POC values.) SC&A had no findings concerning this case in view of DCAS-PER-066.

4.0 SUMMARY CONCLUSIONS

Under SC&A-TR-PR2009-0002, *A Protocol to Review NIOSH's Program Evaluation Reports (PERs),* Revision 01 (SC&A 2009), Subtask 4 requires the audit of DR cases reworked as a result of the PER under review. For DCAS-PER-066, 57 cases met the applicable criteria.

During the May 16, 2016, PRSC meeting, SC&A was tasked with evaluating the appropriate cases concerning the application of DCAS-PER-066.

This current report satisfies the Subtask 4 requirement. For the two cases selected from the 57 cases impacted by DCAS-PER-066, SC&A provided an overview of the case and a brief comparison of doses assigned in the original DRs and the revised dose estimates. Based on directives from the PRSC, SC&A's audit of the two cases focused on those elements of the DR that were affected by the issuance of DCAS-PER-066. Therefore, the audit determined if internal doses were appropriate for these cases, and, if so, whether they were assigned correctly.

As discussed in Sections 2 and 3, SC&A found that NIOSH did correctly derive the appropriate doses as recommended by DCAS-PER-066. SC&A had no findings in the two cases reviewed concerning the reworked doses as per DCAS-PER-066, but did have a finding concerning errors in Table 5 of the current TBD (DCAS 2013) for Administrative Workers that need to be corrected as outlined in Section 1.1 of this report.

5.0 REFERENCES

DCAS 2015. *Huntington Pilot Plant Program Evaluation Report*, DCAS-PER-066, Revision 0, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio. November 30, 2015.

DCAS 2013. *Technical Basis Document for the Huntington Pilot Plant, Huntington, West Virginia,* DCAS-TKBS-0004, Revision 01, Oak Ridge Associated Universities Team, Cincinnati, Ohio. December 12, 2013.

OCAS 2008. *Technical Basis Document for the Huntington Pilot Plant, Huntington, West Virginia,* OCAS-TKBS-0004, Revision 00, Oak Ridge Associated Universities Team, Cincinnati, Ohio. August 13, 2008.

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

ORAUT 2003. *Technical Basis Document: Basis for Development of an Exposure Matrix for Huntington Pilot Plant*, ORAUT-TKBS-0004, Revision 00, Oak Ridge Associated Universities Team, Cincinnati, Ohio. October 31, 2003.

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SC&A 2009. *A Protocol to Review NIOSH's Program Evaluation Reports (PERs)*, SCA-TR-PR2009-0002, Revision 01, SC&A, Inc., Vienna, Virginia, and Saliant, Inc., Maryland. December 2009.