PADUCAH GASEOUS DIFFUSION PLANT ISSUES MATRIX (October 2012)

SC&A Update - New or edited information appears in red text

No.	TBD	Issue	Draft SC&A Finding	NIOSH Response
1	0019-2 (Site Description) ***CLOSED***	Enrichment levels achieved could be higher than 2%.	Although assayed specific activity of U-235 in cascade product is consistent with given enrichment level, maximum assayed specific activity of U-234 over 50% higher than default value.	The actual enrichment of uranium at Paducah likely varied through the years but has been reported to be from about 0.7 % U-235 to about 2.5 to 3% U-235. The slightly enriched material was then shipped to Portsmouth where it was further enriched to 3-5% (BJC 2000). A footnote in the previous version of the internal section of the site profile (Berger 2004) stated that the predominant level of the enriched product was 1.5% although enrichments of up to 5% were eventually performed. This footnote could not be traced to a technical reference and was removed in revision 2, dated 04/04/2007. No documents were identified that support an enrichment of up to 5% at Paducah. A nominal value of 2% was assumed and provides a conservative result for the calculated values listed in Table 5-2 of the Internal Dose Site Profile for Paducah in comparison to natural uranium, which is assumed in the reference material (PACE and the University of Utah 2000: BJC 2000).
2	0019-2 ***CLOSED***	Number of workers assigned zero dose needs to be disclosed.	Average recorded doses in Tables 2-2 and 2-3 biased low and mean little without knowing numbers of workers assigned dose values of zero when measured dose was less than MDL.	There is a note at the bottom of Table 2-3 that discloses that the large numbers of zero dosimeter readings have not been included and thus the average values are increased in value. Tables 2-2 and 2-3 are not necessary to be maintained in the site profile as they are not assigned during dose reconstruction. The tables can be removed during the next revision to the Site Description as the assignment of coworker dose is addressed in ORAUT-OTIB-0031.

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3	0019-2 ***CLOSED***	Need to consider operations other than gaseous diffusion.	No mention of smelting operations in Building C-746B or smelting of diffusion barriers during cascade improvement and upgrade programs, which may have contributed significant dose.	The Site Description is intended as an overview of site operations and each Paducah facility is not listed here. Other sections of the site profile do mention Building C-746B. For instance, Building C-746B is called out in the internal section of the site profile which provides guidance for dose reconstruction. The description of Building C-746B can be added to the Site Description during its next revision; however, the performance of dose reconstructions will not be impacted.
4	0019-3 (Occupational Medical Dose) ***CLOSED***	Fails to adequately define and assess occupational medical exposure.	Guidelines referenced for Kathren (2003) need to be applied in a more claimant-favorable manner.	*(SC&A response June 2010 - Rev. 3 of OTIB-0006 (Kathren and Shockley 2005) referenced; asbestos exams cited for completeness.)* DCAS additional response - Based on the 1,224 Paducah non-compensable claims that have been completed to date, no records of PFG exams were found. During dose reconstruction, typically annual X-rays are assigned to overestimate potential X-ray dose, even though the site profile indicates an X-ray frequency of every two to five years. When actual X-ray records are provided by the site, those records are used for X-ray dose assignment. When no records are available, a frequency of X-rays every 2 years is assumed after 1985 and every 3 years is assumed before 1986. The actual X-ray records indicate that the frequency of X-ray exams provided by the site is less frequent than every 2-3 years.
5	0019-2,3,4,5,6 ***IN ABEYANCE***	Contamination control and skin and extremity dose not adequately addressed.	Insufficient information provided regarding radiological controls in place (or lack thereof) for operations that pose potential for exposures. Contamination control was significant problem and should be examined for relevance to skin and extremity dose.	When information is presented that indicates a skin contamination may have occurred, an evaluation is performed during dose reconstruction on a case-by-case basis using claimant records and claimant-favorable methods described in project documents. In addition, modeling programs such as VARSKIN, Microshield, or ATILLA can be used to calculate a skin dose – including dose to the extremities. The TBD will be updated to include current references that are available to assist with the calculation of dose to the skin and extremities. These

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				include OCAS-TIBs-0010 and -0013, which provide guidance regarding geometric correction factors, and, in the case of TIB-0010, methods for calculating extremity dose using the results of ATILLA modeling. Also, OTIB-0017 will be included as a reference for calculating dose to the skin from contamination and hot particle exposure scenarios. Further, the use of VARSKIN to calculate dose to the skin is discussed in OTIB-0017. ***NIOSH ACTION*: Review of available references regarding the estimation of external dose due to skin contamination.** Original response was reworded (see above) to better describe the process and documents used to estimate skin dose and extremity dose. While these documents have existed for a good period of time, they will be referenced directly in the TBD to help ensure a clear path for the DRist in the assignment of skin and extremity dose.
SC&A Response (June 2011): **Agree** that NIOSH has reviewed and cited available references and will include them as appropriate in the revised TBD. Recommend closure of referencing subissue. However, NIOSH agreed following discussion at the July 6, 2011, Work Group meeting that further review on its part is necessary for the broader question of how skin dose is addressed in the context of Tc-99 exposure at all three GDPs. Further elaboration useful regarding chronic vs. episodic, how to attribute skin and beta dose without dosimetry, what operations involved likely Tc-99 exposure, and the significance of missed dose from this source, and how various tools (OTIB guidelines, models) should be applied by dose reconstructors. The Work Group decided to hold this subissue, in the context of potential Tc-99 exposure, **in abeyance**. **Updated DCAS Response (June 2012):** A procedure, ORAUT-RPRT-0059, *"External Exposure to Technetium-99 at the Gaseous Diffusion Plants"* dated 02/07/12 has been written and is being submitted to the GDP Work Group. The procedure provides guidance for the assignment of shallow external dose from Tc-99. **SC&A Response (August 2012):** **Agree** that NIOSH's response is adequate, per email to the work group on Aug 1, 2012. Recommend closure.				
6	0019-4 (Occupational Environmental Dose)	Onsite environmental exposures based on site boundary data.	Basis for applying site boundary monitoring data for onsite ambient occupational dose needed to be reexamined. No corroborating data provided to demonstrate that such measurements are representative.	The external environmental doses assigned during dose reconstruction are based on the highest monitoring data found at the fence line nearest the cylinder yards. In the early periods of operation when it was more likely an unmonitored employee might have been present in the cylinder yards, the dose rates were lower, while in the

No.	TBD	Issue	Draft SC&A Finding	NIOSH Response
	CLOSED			modern era it is unlikely an unmonitored employee would spend a significant amount of time in the cylinder yards. During dose reconstruction, a maximizing dose of 0.260 rem/yr is assigned for unmonitored workers whose job category and/or work location deem them a non-radiation worker. The assignment of 0.260 mrem/yr is higher than assigning a maximizing missed dose based on monthly badge exchanges. For internal environmental doses, the highest intakes from any of the air sampling locations summarized in Tables 4-2 and 4-3 are assigned for unmonitored workers whose job descriptions are clearly that of a non-radiation worker. These intakes include fallout from weapons testing which increase the intakes assigned. The external environmental doses assigned during dose reconstruction are based on the highest monitoring data found at the fence line nearest the cylinder yards, which results in a maximizing dose assignment of 0.260 rem/yr. TLD data from thirty-three locations in and around buildings at Paducah for 1982 and 1984 (Ref # 37840 and 37842) were reviewed. The TLD results for general areas of the site and in buildings, with the exception of higher dose rate areas such as the C-746 cylinder yards and C-400 pulverizer, were found to be reasonably equivalent to the TLD data taken from the twelve air sampling stations located at the security fence and at the perimeter of the site boundary. In the general areas, the data ranged from 14 – 40 mrem/2000 hrs. An outlier in the data was results for the C335-A office, which indicated TLD results up to 107 mrem/2000 hrs. The conclusion is that the environmental dose assessed in the site profile is reasonable and claimant favorable even as compared to known radiological areas of the site.

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7	0019-5 (Occupational Internal Dose) ***CLOSED***	Inadequate characterization of source term for internal exposures.	Two references not fully utilized for defining source term for internal exposures: PACE/Utah (2000) and BJC (2001).	*(SC&A response June 2010 - Both references are now cited and appropriate information provided.)*
8	0019-5, Table 5-2 ***CLOSED***	Isotopic fractions for various enrichments not properly characterized.	Table 5-2 shows some inconsistencies, one being the specific activity of U-235 in 93% feed, which appears to be a factor of 10 too low.	*(SC&A response June 2010 - Former Table 5-2 replaced by new Isotopic concentration table, based on specific PGDP operations involved.)*
9	0019-5, Table 5-4 ***CLOSED***	Default isotopic distribution in Table 5-4 ignores many isotopes associated with RU.	Table 5-4 appears to ignore the information presented in BJC (2001), Table 2.4-1, which lists maximum concentrations of TC-99, Np-237, and plutonium for 11 different operations at PGDP.	*(SC&A response June 2010 -Table 5-4 deleted (isotopic concentrations by operations); BJC reference applied otherwise.)* ***NIOSH to verify maximum source term values reflected.*** The maximum source term values from the current revision of the internal site profile, Rev. 2 dated 4/4/07 (now Table 5-2) were compared and found agreeable with PACE (Ref ID 10870) Table 7.9 (pg. 88) and Bechtel Jacobs Co. (Ref ID 16498) Table 2.4-1 (pp. 30–31).
SC&A Response (June 2011): Agree that NIOSH has verified that maximum source term values are used in the TBD. At its July 6, 2011 meeting, the **Work Group closed this issue.**				
10	0019-5, Table 5-5	Particle size inhaled aerosols assumed not claimant	Table 5-5 cites 5µm AMAD for assumed particle size of inhaled aerosols, although sizes significantly less than that are cited in supporting literature.	*(SC&A response June 2010 -Table 5-5 deleted; no assumed particle size values provided.)*

No.	TBD	Issue	Draft SC&A Finding	NIOSH Response
	IN ABEYANCE	favorable.		***NIOSH to verify particle size assumptions used.*** No specific particle size study was located for Paducah. The 5µm AMAD is used as the default in accordance with ORAUT-OTIB-0060 and as recommended in ICRP (1994, paragraph 5).

SC&A Response (June 2011): **Questions remain**. If 0.5 micron particle size is cited in literature referenced in earlier TBD (see SC&A finding), how is that reconciled with statement that "no particle size study was located for Paducah?" The issue is whether any data exist that would obviate use of the default particle size of 5 microns. At the Work Group's July 6, 2011 meeting, NIOSH agreed that it needed to review available references further to ascertain their standing as credible bases for applying site specific particle size data, although it believes that the 5 micron ICRP default value would be suitably conservative. The Work Group agreed and holds this issue **in abeyance** awaiting NIOSH's assessment.

Updated DCAS Response (June 2012): DCAS has reviewed the references as discussed in the SC&A document; Bruner 1960, PACE and Baker 1987 as well as a series of other documents that discuss or make reference to particle sizes at Paducah. Upon a review of these documents, DCAS could not substantiate the use of a lower particle size smaller than the default assumption of 5 micron AMAD.

The general policy concerning aerosol AMADs applied for dose reconstructions is to use the ICRP default of 5 µm ICRP (1994, paragraph 5) publication 66 unless there is adequate information available to justify the use of another aerosol AMAD. An adequate technical basis would detail the methods used to measure the aerosol in the workplace, where and when the measurements were performed, and the operations that were ongoing at the time of the measurements. In our opinion, most references on the subject, including the two references cited in the review (Baker and Brunner), don't provide a technical basis that is adequate for the purpose of using an aerosol AMAD that is different than the ICRP default of 5 µm. In general, there were only a few mentions of particle sizes above and below 5 µm without any information as to where the information came from and without any supporting information to specify if the information was from a legitimate study. The PACE report stated "*No actual study of particle sizes at PGDP, including locations of measurement, measurement methodologies and results of measurements has been located.*" In the documents reviewed we also found a few common issues that did not support an official particle study:

- An AMAD of 1 µm was mentioned in a couple of documents, not because it was measured but because it was the default workplace aerosol recommended by the ICRP (ICRP 30) at the time of the reports. That AMAD of 1 µm has been superseded by the current default workplace AMAD of 5 µm ICRP 1994 (publication 66).
- An aerosols size in terms of 3.0 -3.5 µm **mass median diameter (MMD)** was mentioned in a couple of documents. In looking at ICRP 66 (1994) equation D.5 in Annex D, an MMD of 3 – 3.5 would be roughly equivalent to an AMAD of 4 -5 AMAD.

SC&A Response (August 2012): **Agree** that NIOSH response is adequate, per email to the work group on Aug 1, 2012, and recommend work group closure.

No.	TBD	Issue	Draft SC&A Finding	NIOSH Response
11	0019-5, Table 5-5 ***CLOSED***	List and quantities of transuranics addressed not complete or claimant favorable.	Table 5-5 limits TRUs to Np-237 and Pu-239; however, TRU in Hanford recycled tails and other sources include Pu-238, Pu-240, and Am-241.	*(SC&A response June 2010 -Table 5-5 deleted; more comprehensive radionuclide source term provided)* ***NIOSH to verify maximum source term values reflected (combined with #9 above)*** The maximum source term values from the current revision of the internal site profile, Rev. 2 dated 4/4/07 were compared and found agreeable with PACE (Ref ID 10870) Table 7.9 (pg. 88) and Bechtel Jacobs Co. (Ref ID 16498) Table 2.4-1 (pp. 30–31).
SC&A Response (June 2011): Agree that NIOSH has verified that the maximum source term values are used. At its July 6, 2011 meeting, the **Work Group closed this issue.**				
12	0019-5, Table 5-5 ***CLOSED***	Lung clearance types need to be clearly defined.	Table 5-5 not clear "absorption type" for each radionuclide is consistent with chemical forms, and that most claimant-favorable assumption will be applied by dose reconstructor.	*(SC&A response June 2010 -Table 5-5 deleted.)*
13	0019-5, Table 5-6 ***CLOSED***	Intakes based on bioassay data need to take into consideration frequency of sample collection.	Table 5-6 default frequencies for in-vitro measurements at various PGDP facilities not claimant favorable, given that intervals between measurements could have been as long as 1 year versus 4-week interval provided.	The default frequencies for bioassay are not used when assessing an individual's dose – the actual sample dates for the specific individual are used).
14	0019-5, Table 5-7 ***CLOSED***	Minimum detectable concentrations (MDCs) not clearly defined.	In many cases, MDCs cited could not be verified through their reference documents.	*(SC&A response June 2010 -Additional reference cited; more specificity given for reference documents cited.)*
15	0019-5	Day of sample collection needs to be taken into consideration when deriving intakes	Practice of offsite collection of samples 24-48 hours after leaving the plant, with PDGP employees being asked to collect samples after 1 or 2 days off from work would lead to lowering of calculated intakes, which is not addressed in guidance to dose	This is a programmatic issue not specific to this site profile. Differing sampling frequencies and criteria is normal and understood. Sampling dates are provided with bioassay

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<tr><th>No.</th><th>TBD</th><th>Issue</th><th>Draft SC&A Finding</th><th>NIOSH Response</th></tr>
<tr><td></td><td><u>CLOSED</u></td><td>based on urinalysis.</td><td>reconstructors.</td><td>records which are to be used rather than an assumed bioassay date. NIOSH assesses two types of intakes: intakes from positive results and missed intakes from negative results. Missed intake is assigned based on a theoretical assumption of a continuous intake that was not detected on the date(s) of sampling; in this situation (no detectable intake) additional detail of monitoring protocol is not needed because a continuous intake is assumed up to the limit of detection, unless other information indicates the individual had no potential for exposure.

If a positive bioassay result(s) is in the records, the DR must consider all available information, including, but not limited to, individual records, information provided in the TBD, and the actual dates of bioassay collection. Thus, an intake based on a positive bioassay is case-specific based on all available data.

<u>NIOSH ACTION</u>: Need to evaluate scope and significance of issue at Paducah, and implications to coworker model dose estimations.

A review of the sampling frequencies was performed with the results below. There is not a significant increase in the number of samples obtained on Mondays.

PGDP Urine Samples

<table>
<tr><th>Day of Week</th><th>through 1977[a]</th><th>1977-1988[b]</th><th>Sum</th><th>Fraction of total</th></tr>
<tr><td>Sunday</td><td>2923</td><td>384</td><td>3307</td><td>2%</td></tr>
<tr><td>Monday</td><td>30013</td><td>15507</td><td>45520</td><td>30%</td></tr>
<tr><td>Tuesday</td><td>21750</td><td>5944</td><td>27694</td><td>18%</td></tr>
<tr><td>Wed.</td><td>24781</td><td>14738</td><td>39519</td><td>26%</td></tr>
<tr><td>Thursday</td><td>13377</td><td>6248</td><td>19625</td><td>13%</td></tr>
<tr><td>Friday</td><td>12967</td><td>3776</td><td>16743</td><td>11%</td></tr>
<tr><td>Saturday</td><td>1079</td><td>193</td><td>1272</td><td>1%</td></tr>
</table>
</td></tr>
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No.	TBD	Issue	Draft SC&A Finding	NIOSH Response
SC&A Response: SC&A's June 2011 response indicated that it was not clear how a 30% fraction on Mondays (with 44% the following two days) does not represent a "significant increase" in sampling frequency in the context of this issue, and that while it is acknowledged that this issue resolves itself for individual dose reconstructions, it is less clear how this is resolved in the coworker model. **NIOSH** at the July 6, 2011, work group meeting, indicated that while Monday urinanalyses does represent an under-estimate, particularly of Type F uranium over a weekend time lag, Tuesday through Friday urinalyses represent an over-estimate and more than offsets the Monday influence on the overall distribution of bioassay results providing a claimant favorable outcome. On the basis of NIOSH's explanation, the **Work Group closed this issue**.				
16	0019-5 ***CLOSED***	Additional significant incidents with internal dose potential need to be discussed.	Significant information useful to dose reconstructors is not included, including statements by workers that urine specimens were collected within 30 minutes of an incident which does not allow time for equilibrium to be achieved between inhaled activity and concentration in urine. Also, bioassays performed not always entered into employee's dose record.	This can be noted in the site profile but incidents are typically noted in a worker's file so the DR would be aware that a particular sample was collected shortly after a potential intake. This will likely have little impact on dose reconstructions. PGDP collected many samples from each worker so if a sample were collected only 30 minutes after an incident, which would be insufficient time for transport of the material to urine, the next sample could be used for the assessment of the acute intake. ***SC&A to compare Pace 2001 incident list with Table 5-8 TBD listing.*** NIOSH compared the incident list in the TBD, Table 5-8 with PACE (pp. 31, 51–52) and BJC (pp. 5–7) and they were found to be agreeable. When the TBD is updated, the note to Table 5-8 will be changed to reflect that additional information may be found in the PACE report (Ref ID 10870 and BJC 2000 (Ref ID 16498).
SC&A Response (June 2011): **Agree**, although this comparison should be discussed with the Work Group at its next meeting. Otherwise, would recommend closure. At its July 6, 2011 meeting, SC&A and NIOSH agreed that its comparison of these references indicated comparability. On this basis, the **Work Group closed this issue**.				
17	0019-5	Coworker model for applying bioassay data to unmonitored workers is neither scientifically valid	In the coworker model, workers are not classified by their jobs or by the buildings where they performed their work, and no validation is provided that there is a low probability that any unmonitored worker could have a higher exposure than the monitored workers	Typically unmonitored workers have a lower potential for exposure to unconfined radioactive material. However, claimant-favorable internal doses are assigned based on their jobs and the buildings where they performed their work. Coworker doses are statistically

No.	TBD	Issue	Draft SC&A Finding	NIOSH Response
	IN ABEYANCE	nor claimant favorable.	taken as a group.	valid and include a number of overestimating assumptions, including the fact that U-234 was selected as the isotope that would result in the highest internal dose when representing "uranium." Part of the rationale is due to the dose conversion factors for U-234 being 7% to 31% larger than those for U-235, U-236 and U-238 (ICRP 68) as well as other factors. ***NIOSH to provide reference for evaluating job title and work category in coworker applications.*** For internal dose assignment, ORAUT-OTIB-0014 provides guidance to dose reconstructors on when they can assign environmental internal doses rather than potential workplace exposures to workers and the methodology for assigning such doses. Section 3 discusses identifying employees for whom environmental internal doses are appropriate based on job description, work location, monitoring data, etc. Attachment A also provides job categories and a general indication of potential for exposure. When the TBD is changed, ORAUT-OTIB-0014 will be added as a reference. ***See also, response to Item 20.***

SC&A Response (June 2011): **Disagree** that OTIB-0014 satisfies the need for site-specific information regarding job categories and/or buildings where workers performed work; this OTIB provides general information on how to assign environmental doses vs. workplace doses, with Attachment A providing illustrative "examples" of general job categories and their corresponding potential for environmental internal exposures. SC&A agrees that OTIB-0031 Table 2 serves to illustrate that the most highly exposed workers were monitored before 1960. At the July 6, 2011 Work Group meeting, NIOSH indicated its agreement that OTIB-014 is not adequate for guidance and that OTIB-060 would be more applicable; however, it is clear that more site-specific job categories and work locations would facilitate coworker application by dose reconstructors. Based on this discussion, the Work Group decided to **hold this issue in abeyance** until NIOSH can provide clearer and more applicable guidance.

Updated DCAS Response (June 2012): Discussion about assignment of unmonitored dose is in the Internal TBD and additional information is being added to discuss the assignment of unmonitored/Coworker dose. The three different type of unmonitored dose are environmental dose, the full distribution coworker dose, and the 95th percentile intake applied as a constant distribution. In most cases, environmental unmonitored dose or the full distribution of co-worker doses are assigned and provide claimant favorable internal dose. However, in certain instances, a worker may be assigned the 95th percentile of a constant distribution. Discussion of when a dose

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reconstructor should consider assigning the 95th percentile is being added to the internal TBD. **SC&A Response (August 2012):** **Agree** with NIOSH approach, per email to the work group on Aug 1, 2012, albeit the work group may want to review the additional information once it is added to the TBD. Recommend closure of this item given NIOSH's commitment to add the appropriate information as noted.				
18	0019-5 ***CLOSED***	Method of converting mass concentrations of uranium to 24-hour excretions of activity of uranium isotopes is not valid.	Default specific activity provided in the internal dosimetry coworker model (Ikenberry 2005) should be increased from 0.0389 Bq/µg to 0.0541Bq/µg, and the daily excretion rate of urine should be updated to reflect the latest ICRP recommendations.	Based on a reasonable enrichment of 2%, 0.0389 Bq/ug is the correct specific activity. The specific activity was calculated using information from Table 5-2 of the internal section of the site profile. Adding the uranium constituents from any column of the table results in a specific activity of 1.05 E6 pCi/g or 0.389 Bq/µg. The specific activities were taken from the Internal Dosimetry Technical Basis Document for Bechtel Jacobs Company. Also, see response to issue #1 concerning 2% enrichment. The current ICRP models are based on Reference Man, ICRP 23. The daily excretion rate from that document is used project wide and is not specific just to the Paducah site profile.
19	0019-6 (Occupational External Dose) ***CLOSED***	Shallow dose from beta emitters may have been underestimated.	The TBD indicates that film badges used to derive skin doses from beta emitters employed minimum absorber thickness of 80 mg/cm^2 between the film and the source, but film badges appear to have been calibrated with a uranium slab without the absorber. ***Also, the calibration factor used ignores the contribution of lower energy betas from the short-lived daughters of U-238 and U-235, which would have been filtered out by the absorber thickness.*** [This additional issue inadvertently left out of original SC&A matrix issue statement.]	The available evidence [SRDB 13681, 8573, 11985] indicates that the entire combination badge (i.e., badge with plastic laminated photograph or security credential) was exposed during the beta calibration. As a result, the decrease in optical density compared to the open window dosimeter was correctly considered during the calibration. The document authored by Thornton, Davis, and Gupton 1961 [SRDB 8573] contains an abundance of Combination Badge beta energy response considerations and data. There is incorrect information on Table 6-1 which may have led to some confusion regarding two-element film. Table 6-1 of the Paducah External TBD will be modified to reflect that two-element film (not four-element film) was used from 1953 – July 1960.

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20	0019-6 ***CLOSED***	Questionable assumptions made for assigning skin and deep dose for unmonitored workers prior to 1960 by means of coworker data.	Coworker model assumes that, prior to 1960, populations of monitored workers included those individuals with the highest exposure potential, an assumption that may be questionable given that the badging practice at the time was to include all worker categories regardless of their potential for exposure.	*[SC&A response - Appears to be resolved with issuance of ORAUT-OTIB-0031 (Merwin 2006)].* ***NIOSH to provide reference for evaluating job title and work category in coworker applications (OTIB-0020?), and how issue of possible cohort badging prior to 1960 would influence coworker model.*** ORAUT-OTIB-0020, Section 3.0, addresses the topic of evaluating job title and work category in order to select the proper coworker percentile value (either 50th or 95th percentile) when using coworker data found in ORAUT-OTIB-0031. A reference to OTIB-0020 currently appears in OTIB-0031 and will be added to the TBD. The below table, "OTIB-0031 Table 2 Figure" illustrates that the most highly exposed workers were monitored before 1960. This is most notable when looking at the plot of median dose – there is an easily observable decrease in this value at and after 1960. This decrease is also illustrated by the 95th percentile plot. This data trend indicates the highly exposed population was monitored prior to 1960, and the whole population of likely exposed workers was monitored after that date as indicated in Section 4.2.1.1 of the PACE report.
SC&A Response (June 2011): <u>Agree</u> that NIOSH's OTIB-0031, Table 2, serves to illustrate that the most highly exposed workers were monitored before 1960. Recommend closure. Following work group discussion on July 6, 2011, the Work Group closed this issue.				
21	0019-6	Assessment of neutron exposures appears to underestimate dose.	Based on the TBD, it appears that reliable monitoring of neutron exposures did not begin until 1998, and the coworker model may not adequately account for missed neutron dose prior to 1960 (relying on n/p ratios and review of worker activities	If an unmonitored worker has radiological exposure potential based on their occupation and/or work locations, then photon coworker doses will be assigned. The n/p ratios are then applied to photon coworker doses to determine unmonitored neutron dose. Prior to 1960,

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	CLOSED		during 1960–1998).	the photon coworker doses are higher when it was more likely that the dose rates in the cylinder yards were lower. However using the n/p ratio, the unmonitored neutron dose assignment would also be higher prior to 1960.
22s	0019-3 ***CLOSED***	Additional factors that contribute to uncertainties.	The TBD does not consider dose impacts due to less-than-optimal use of technology and how that can contribute to uncertainties between units.	***ACTION: NIOSH will consult with medical x-ray staff resource and provide response.*** Doses in the Paducah TBD for 1975 and later are based on documented *facility-specific* technique factors and standard x-ray machine output tables (NCRP 102). Technique factors (machine settings of kVp, mA, and time) must be specifically designed to be used with a given film speed, intensifying screen speed, development process, and other technological factors. Therefore, if technique factors for a given machine are known, or can be reasonably assumed, then detailed knowledge of the film/screen combination or other technology is not necessary, as the technique factors themselves have been designed to produce adequate images given those other factors. Doses for 1974 and earlier are based on conservative entrance air kerma values from ORAUT-OTIB 0006, which are based on actual measurements in published, contemporaneous medical literature. Using entrance air kerma values as the starting point for dosimetry obviates the need for detailed knowledge of site-specific technology, such as film, screens, processing, grids, etc. The use of the conservative entrance air kerma values from ORAUT-OTIB-0006 is used across the DOE complex when site-specific information is not available. As a result of using site-specific technique factors (post-1975) or conservative entrance air kerma values from ORAUT-OTIB-0006 for x-ray dosimetry in the Paducah

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				TBD, the need for detailed information about screens, grids, film, and bucky systems is not necessary. This approach permits dose reconstruction to be performed regardless of subjective judgment of whether technology actually used was optimal or not.
SC&A Response (June 2011): **Agree** that the need for more detailed information regarding screens, grids, film, and bucky systems is not necessary if use is made of site specific technique factors (post 1975) or conservative entrance air kerma values from ORAUT-OTIB-0006 for x-ray dosimetry in the Paducah TBD. At the July 6, 2011 work group meeting, NIOSH noted that a more complete discussion along the lines of their response would be included in the next TBD revision. Based on this discussion, the Work Group **closed this issue**.				
23s	0019-5 ***CLOSED***	Erroneous equations for estimating 24-hour excretion.	The provided equations for estimating 24-hour excretion on the basis of spot urine samples incorrectly written.	***ACTION: NIOSH will follow up.*** The equation was based on NCRP Report 87 to be used when specific gravity was reported for a sample and could be used to derive a urinary excretion rate. The urine specific gravity was never used by NIOSH during dose reconstruction for Paducah claims and was subsequently deleted from the Internal TBD. There are no tools used during dose reconstruction that use the erroneous equation.
SC&A Response (June 2011): **Agree** that the explanation satisfies the substance of the concern, but a commitment to delete or change this equation (and notice the error to DRs) is warranted. At its July 6, 2011 meeting, the **Work Group closed this issue**.				
24s	0019-5 ***IN ABEYANCE***	Use of unverified bioassay data.	The database for internal dose data (1952–1976) was not verified by DOE for completeness and accuracy, and it is not clear if NIOSH has done so.	***ACTION: NIOSH will review pedigree for database and determine if it has been verified and validated (V&V).*** There appears to have been little V&V on the early (pre-1977) bioassay database. Individual hard copy records are available in the claimant (NOCTS) files so although it would be an extensive effort, verification could be performed.
SC&A Response (June 2011): **Issue persists**. How can NIOSH (and the Board) establish its confidence regarding the completeness and integrity of the database without some degree of validation? This should be discussed at the next Work Group meeting with an eye toward some reasonable course of action (e.g., limited data sampling). At the July 6, 2011 work group meeting, NIOSH agreed to the need for some sampling means to validate data integrity of the electronic database provided				

No.	TBD	Issue	Draft SC&A Finding	NIOSH Response
by DOE (which had not completed V&V). The Work Group decided to **hold this issue in abeyance** awaiting NIOSH's assessment. **Updated DCAS Response (June 2012):** A V&V effort was completed by performing limited sampling of two of the plant databases. A white paper titled, **"***Comparison of Paducah Gaseous Diffusion Plant Hardcopy Bioassay Records to Two Plant Databases"* dated 03/12/12 describes the analyses that were performed, The evaluation looked at 614 separate lines of data which consisted mostly of a comparison of handwritten logbooks bioassay records against the database used for generating the coworker database. Of the 614 lines evaluated, there were 30 errors that could affect the Paducah uranium bioassay coworker study. These 30 errors would represent an error rate of less than 5% and consisted of four incorrect dates, two incorrect bioassay results, and twenty four data entries that were found in the logbook but not in the database used to generate the co-worker data. Considering the large volume of data evaluated in compiling the coworker study (approximately 159,641 lines of data), a very small percentage of sample dates and urinalysis results errors, and the omission of a small percentage of line entries, there would likely be little to no effect on the coworker intakes calculated from the data**.** **SC&A Response (August 2012):** SC&A **agrees** with NIOSH's sampling approach and conclusions regarding data validity, per email to the work group on Aug 1, 2012. Recommends closure by the work group.				
25s	0019-5 ***CLOSED***	Incorrect selection of distinct time periods.	Not clear why two time periods used in assessing chronic intake period when data suggest three distinct periods.	***ACTION: NIOSH will evaluate how chronic intake periods determined and whether, in any case, the difference in results is consequential.*** SC&A divided the data into three periods instead of two distinct periods as NIOSH did. SC&A provided no basis why they consider the data to represent three distinct periods. Using the mean and standard deviation for the first two periods derived by SC&A, the difference between the means is 0.116 with a standard deviation of 0.115. This indicates the difference between the first two periods from SC&A as not statistically different from zero at the 95% confidence level. By contrast, the difference in the means between the first and third periods proposed by SC&A is 0.314 with a standard deviation of 0.087 which is statistically different than zero. This implies that the two periods selected by NIOSH provide an appropriate separation of data sets.
SC&A Response (June 2011): **Agree** that there is little statistical difference between the two time period formats. Recommend closure. At its July 6, 2011 meeting, the **Work Group closed this issue**.				