Draft

ISSUE RESOLUTION MATRIX FOR PINELLAS PLANT

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Issue No.	Issue	SC&A Statement
1	**Reconstruction of doses in the absence of early health physics, industrial hygiene, and environmental records.**	The absence of pre-1980s records brings into question the ability to adequately assign radiation doses during the early years at Pinellas. The improvements in radiological monitoring and bioassay methodology, instrumentation, and in health physics, industrial hygiene, and environmental control programs, contraindicate the use of 1980s documentation for determining radiation doses for the early years of plant operations. The assumptions incorporated into ORAUT-TKBS-0029-4 and ORAUT-TKBS-0029-5, given the absence of firm information, appear to be claimant favorable. However, the uncertainties associated with projections without documentary evidence may result in missing doses that may not be accounted for by the claimant-favorable assumptions indicated in the documents.
Issue 1: Closed during the 11/19/2012 WG meeting; see transcript page 12. Technical basis documents (TBDs) updated in 2011.		
SC&A response – 01/05/2016: Concur. **SC&A 03/14/2016:** Issue discussed pp. 8–12 of the 11/19/2012 Work Group (WG) teleconference. TBD-6 p. 54, Table B-1 provides an evaluation of Pinellas Plant doses available in the Site Research Data Base (SRDB) from 1957 to 1995 that form the basis for the whole-body dose coworker model. There is no paucity of dose data prior to 1980.		
2	**Potential doses from insoluble metal tritides not sufficiently addressed.**	The neutron tube manufacturing process required spray-coating the inside of a glass tube with a thin metal film, resulting in the formation of insoluble stable metal tritides (SMTs), namely ScT_2, ErT_2, and TiT_2. There is no internal documentation indicating that there were adequate means of detecting exposures or monitoring SMTs. No guidance is provided for estimating the exposure to metal tritides; in fact, Section 5.9.2, Metal Tritide Exposures, is reserved for later entry. The practice of destructive testing of neutron generators and the methodology for performing the testing make it possible that exposures to metal tritides occurred. Further discussion of the potential exposure pathway and doses should be included in ORAUT-TKBS-0029-5, when Section 5.9.2 is completed.
Issue 2: This issue remains open. NIOSH plans on completing the tritide approach in December 2015. See 11/19/2012 WG meeting see transcript pp. 13–26.		

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<tr><td colspan="3">SC&A response – 01/05/2016: Concur.

SC&A 03/14/2016: Update from February 11, 2016, WG meeting

NIOSH document describes updated SMT model that is based in large part on the SMT model approved for Mound: Review of NIOSH's Current Approach to Reconstruction of Insoluble Tritium Particulate at the Pinellas Facility, December 11, 2015. (See file "dc-pinellastrit-r0.pdf" on the DCAS website). Five aspects are addressed:

1) Resuspension factor: Increased from 1E-6 to 5E-5 per meter (same as Mound).

2) The use of the highest contamination survey reported between 1957 and 1973 as the basis for the airborne contamination source term: Based on monthly health physics summary reports that report the highest contamination levels for a given month. Assumes average contamination level of 4.4E+06 dpm/100 cm^2 is one to two orders of magnitude higher (depending on the year) than the surface contamination levels at Mound.

3) The ability of the method used to measure smear samples to detect tritium bound to particulate metal: Method used cotton ball swipe, then rinsed with DI water into a cup and filtered through Whatman #1, the LSC. Tritiated water (HTO) emissions about 2 to 3 times that from particulates (SRDB 12275, pp. 9–11), so even if particulates trapped in cotton, still have much higher (bounding) HTO value.

4) The magnitude and the extent of potential for tritide contamination at Pinellas: SMTs only handled in areas where tritium was handled and all tritium workers were monitored. Model only applied to those with tritium bioassay (not a coworker model).

5) The relative solubility of the various metal tritides present: Assume all Type S (scandium) even though most was Type M (claimant favorable).

SC&A presented a white paper response to the NIOSH tritide model: Review of Proposed Stable Metal Tritide Dose Reconstruction Methodology at Pinellas, February 4, 2016 (seven observations and a single finding, later withdrawn upon clarification from NIOSH) (see file "sca-pinetritmeth-r0.pdf" on the DCAS website).

After discussions focused mostly on the applicability of the sample method (NIOSH Item 3), and the documentation supporting prompt cleanup of spills and contamination that evidenced a strong health physics program, SC&A and the WG concurred that the NIOSH model is sufficiently accurate and claimant favorable. The WG accepted the SMT model and motioned to put Issue 2 into abeyance until the TBD is revised.

A remaining SC&A concern was how NIOSH accounts for organically bound tritium (OBT). The TBD does not discuss OBT in any detail. NIOSH responded that OBT behaves more like an insoluble particulate than HTO and is subsumed in the SMT dose. NIOSH indicated that the next TBD revision will include a discussion of how intakes of tritides, OBT, and HTO are addressed individually.</td></tr>
<tr><td>3</td><td>MDCs and uncertainties for plutonium and bioassay measurements are inadequately addressed (ORAUT-TKBS-0029-5).</td><td>ORAUT-TKBS-0029-5 should provide more information about how bioassay sample activity concentrations were calculated and the uncertainties associated with these values. NIOSH should provide information on the use of the values in Table 5.1 to calculate internal doses.</td></tr>
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Issue 3: Closed before the 11/19/2012 WG meeting; see transcript page 27. TBDs updated in 2011.		
SC&A response – 01/05/2016: Concur. **SC&A 03/14/2016:** This was a concern early in the issues resolution process, when some potential exposure to plutonium (Pu) was not ruled out. Based on discussions at the October 2011 WG meeting, it was determined that the only source of potential intake was from handling of newly received triple encapsulated radio-thermal generators (RTGs). However, there was no surface contamination greater than 200 dpm (the rejection level), and NIOSH calculations show that to receive even 1 mrem annual dose would require handling thousands of RTGs in a year. Therefore there is no credible source of exposure. In Revision 2 of TBD 5, all Pu discussion was removed based on discussion at the October 2011 WG meeting. If evidence of a positive exposure is discovered, NIOSH will need to develop a dose reconstruction (DR) methodology.		
4	**Assessment of personnel badging policy during early years needs further review.**	ORAUT-TKBS-0029-6 states, *From 1960 to 1973, U.S. Atomic Energy Commission (AEC) annual exposure summary reports indicate that Pinellas had 27.5% of its labor force wearing dosimetry (377 of an average yearly labor force of 1,372). During the 1980s, while the data are not completely available, from 370 to approximately 400 of 1,650 to 1,975 workers (approximately 20%) were monitored for radiation dose. No documentation was found to show that all employees were monitored at some time during Pinellas operations.* It is important to know who was considered a "radiation worker" and how they were selected for badging, as this has dose consequence. In that era, radiation hazards were not well recognized. This resulted in some workers not being monitored during a period when not all radiation hazards were recognized. The TBD does not clearly address these issues by clarifying the basis for how monitoring was conducted, nor which worker categories were badged. These issues need to be reviewed and substantiation provided that the maximally exposed workers were badged, and that there is a means to estimate radiation dose to unmonitored support workers with access to production areas. Additionally, since many Pinellas records on facility monitoring, safety evaluations, investigations, etc., prior to 1980 are not available, the determination of the adequacy of badging assignment and allocation of unmonitored dose will be complicated. The impact of this absence of early information should be addressed.
Issue 4: Closed during the 6/11/2009 WG meeting; see transcript page 33. TBDs updated in 2011.		
SC&A response – 01/05/2016: Concur. The possibility of cohort badging was an early concern. It was later clarified that the health physics program monitored those with exposure potential and there was no cohort badging (6/11/2009 WG transcript (pp. 30–33). Also note that the DCAS coworker model that assigns the 95th percentile whole-body dose to all unmonitored workers obviates this issue.		

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5	**Problems with personnel dosimetry.**	Section 6.2.2 of ORAUT-TKBS-0029-6 states, *This analysis was unable to locate specific designs of the film dosimeters used for approximately the first 20 years (1957 to 1974) at the Pinellas Plant, and there is limited documentation that indicates there was an early relationship with Nuclear-Chicago (GEND 2004a).* Table 6-5 on page 16 of ORAUT-TKBS-0029-6 assigns a missed dose of 0.24 rem for beta-photons (monthly) for badges used during this time period. This assignment of missing dose evidently assumes that the badges used during this time period were equivalent to those provided by Nuclear-Chicago. Additional discussion is needed on the uncertainty associated with the assumed missing dose, given that the origin of the dosimetry is not clearly established.

Issue 5: Closed during the 6/11/2009 WG meeting; see transcript page 51. TBDs updated in 2011.

SC&A response – 01/05/2016: "In abeyance" at 6/11/2009 meeting. Discussed again at 11/19/2012 meeting.

Remaining **open** sub-issue was the basis for the limit of detection (LOD) of 10 mrem for the post-1974 period in Table 6-9 of TBD-6 instead of the SC&A-recommended 20 mrem. (See Attachment 2 of *SC&A Pinellas Plant Work Group Update November 19, 2012, Teleconference meeting* for a description of Issue 5 as it stood prior to the November 19, 2012, meeting. That document is available on the DCAS website.)

Post-1974 sub-issue discussed on pp. 44–50 of the 11/19/2012 transcript, p. 50: NIOSH (Brian Gleckler) was going to look into the basis for an LOD of 10 mrem instead of SC&A-recommended 20 mrem. On 12/07/2015, John Stiver asked Joe Zlotnicki (SC&A, former Vice President of Landauer) through email to respond. He indicated that 10 mrem is probably acceptable for 30–250 keV photons but is concerned that the gamma spectrum from an RTG source would be hardened. The question is the film's ability to detect low dose under the conditions encountered at Pinellas. SC&A is still looking into this and will be prepared to discuss at the February 2016 WG meeting.

SC&A 03/14/2016: SC&A found evidence that there was probably spectral hardening from the shielding provided by the triple encapsulation of the RTG Pu-238 heat sources. This issue was discussed at length at the 02/11/2016 WG meeting, where the WG agreed to hold a technical call with [redacted], a recognized expert in film badge dosimetry, to help reach closure. That call took place February 26, 2016.

Dr. [redacted] indicated that for high-energy gammas (above 250 KeV), optical density (OD) was converted according to a step function (not a Gaussian distribution). The minimum increment in OD on the densitometer corresponded to 6 mR, so doses would be 6, 12, 18, and 24 mR. The minimum reportable dose (also referred to as the LOD, of 10 mR was not defined by a statistical basis; rather, Landauer adopted the convention that doses less than 10 mR were not significant – so 9 mR or less was treated as 0, 10 to 14 treated as 10, 15 to 24 as 20, and so forth. In other words, doses were reported in 10 mR increments (no intermediate doses) even though the densitometer was "calibrated" to 6 mR increments. Note that for lower energy x-rays, the system was capable of detecting 3 mR (step function of 3, 6, 9, 12 mR…). Thus, actual doses of 9 mR were detectable but not reported as such. In summary, Landauer did not have a separate detection limit for every energy – it was not practical at the time.

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DOELAP accreditation guidelines for determining the lower limit of detection (LLD) for a counting system were based on Poisson statistics, such that the Type 1 and 2 error rates (false positive and false negative, respectively) were both controlled at 5 percent. Film for high-energy exposure has an LLD of 12–14 mR; thus, for 95% of the time will get 10 or 20 when exposed to 12. On customer control badges, Landauer accounted for change in base fog not accounted for in Landauer's own control badges. Would use customer controls and ours – adding or subtracting depending on the difference; but would also have in-house control as reference point, done on monthly basis. Thus, age of film doesn't change the sensitivity, because of accounting for increased base fog/time at Landauer and adjusting for differences between customer and Landauer control exposures. SC&A's concern was that in a high gamma field, 10 mR might not be detectable. However, according to Dr. [redacted], we would still have a 95% chance of detecting a true exposure at that level. Based on the forgoing discussions, SC&A is satisfied that the minimum reported dose of 10 mR for Landauer film, for the period of use in question at Pinellas (1974 to 1979), has a sound scientific basis, and recommends that sub-issue 5 be closed. **At the March 1, 2016, WG meeting, the WG motioned to close Issue 5.**		
6	**The decontamination and decommission (D&D) era of Pinellas operations is not sufficiently addressed.**	Monitoring practices, particularly internal dosimetry, are not specified in the TBD for the D&D period (1995–1997) at the Pinellas Plant. A number of questions present themselves that are not addressed by the existing Pinellas Site Profile. What specific external and internal monitoring program was established for D&D operations, and how effectively was it implemented? With the use of first-, second-, and third-tier subcontractors, to what extent were these workers "captured" in the site's dosimetry program, and were their records maintained? How would the coworker dose model be applied for unmonitored workers located adjacent to D&D operations; was resuspension of radioactive particulates an on-site issue during D&D? Buildings at Pinellas were designed and constructed to provide ventilation systems, fumehoods, and gloveboxes to minimize inhalation uptakes by workers. As demolition workers began to remove walls and dividers, and to remove these contaminated fumehoods, gloveboxes, and ventilation systems, these engineering controls were breached and no longer became effective in minimizing inhalation uptakes. Contamination within the ventilation ductwork would have been an additional source of uptakes. Not always being aware of the presence of radionuclides in specific demolition areas and/or researcher-handling areas made it difficult to adequately prevent, monitor, and detect uptakes of these radionuclides.
Issue 6: Closed during the 6/11/2009 WG meeting; see transcript page 51. TBDs updated in 2011.		

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SC&A response – 01/05/2016: Open; discussed at the 11/19/2012 WG meeting. The Subject Matter Expert (SME) from January 2012 interviews indicated that all the contract employees were monitored by Pinellas RadSafe before, during, and after the D&D operations. Issue remained open pending NIOSH receipt of confirmatory D&D monitoring records from Albuquerque (11/19/2012 transcript, pp. 53–54). **SC&A 03/14/2016:** During the February 11, 2016, Pinellas WG meeting, NIOSH described its SRDB holdings for the site. NIOSH has captured 5,161 references in the SRDB. This represents an exhaustive search for Pinellas records and includes records searches at Albuquerque. Accordingly, the WG had placed this issue in abeyance until delivery of the Sandia National Laboratories (SNL) finding aid. NIOSH received the finding aid on March 1, 2016, and assessed its usefulness based on keyword searches. Based on their review, NIOSH believes that none of the documents in the SNL finding aid will add to our understanding of the D&D activities at Pinellas. This issue was discussed again at the March 1, 2016, WG meeting. It was determined that NIOSH has probably found all available monitoring records for the period in question. That, in combination with the SME interview, provides a strong weight of evidence argument that DR is feasible during the D&D period. **The WG, therefore, motioned to close Issue 6.**		
7	**Missing internal dose estimation methods for unmonitored workers, e.g., maintenance and support personnel, not provided.**	It is not clear from the internal dosimetry TBD (ORAUT-TKBS-0029-5) how dose estimation would be performed for maintenance and support workers who were not classified as radiation workers and who had access to Pinellas Plant radiological operations. Section 5.9.1 of ORAUT-TKBS-0029-5 contains the statement: *All HTO and Plutonium potentially exposed workers have likely been monitored.* The basis for this statement needs justification, particularly in light of the fact that tritium use and contamination were common in many Pinellas areas that may have been accessible to maintenance and, possibly, administrative personnel. However, no guidance is provided in this TBD with respect to missed dose calculations for unmonitored workers in the category of support personnel, whose actual jobs (contamination spill cleanup, equipment maintenance, janitorial functions) and whose access to various Pinellas buildings may have led to radionuclide exposures over their job history. It is also not clear how the designation of "radiological worker" was historically defined at Pinellas, and how workers were selected on this basis for bioassay for various operations.
Issue 7: Closed. See 11/19/2012 WG meeting; see transcript p. 55. TBDs updated in 2011.		

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SC&A response – 01/05/2016: Concur: However, there is some confusion here. The issue closed on p. 55 of the 11/19/2012 transcript was not Finding 7 (above) from the original issues matrix. Rather, it was the 7th item that SC&A was tasked to look at during the October 2011 WG meeting (TBD-3 issues). For Finding 7 from the original matrix (missing internal dose estimation methods for unmonitored workers), TBD-5, Revision 02 addresses SC&A's concerns. The NIOSH "whole-body dose" coworker model includes a tritium component in addition to neutron and external gamma dose assigned at the 95th percentile. That, in combination with no documented plutonium exposure potential (Issue 3) and the closure of secondary Issue 2 regarding nickel-63 (Ni-63) and carbon-14 (C-14), appears to address other aspects of Finding 7.		
8	**Potential for missed dose for depleted uranium.**	Section 2.3.2 contains a discussion of depleted uranium, including the statement: *The depleted uranium metal was fully contained inside the storage flask, and no information could be found to indicate that depleted uranium metal was released during plant operations (Ward, p. 12).* Interviews with a former employee raised the possibility of loose depleted uranium (DU) contamination in an area of Building 100. There were no bioassay programs in place to determine internal dose from exposure to DU; thus, DU internal exposure could represent a significant source of unmonitored exposure. There is minimal information in ORAUT-TKBS-0029-2 on the production of the tritium beds, so it is not possible to discern if the process involves operations that could lead to internal exposures. Further discussion of the DU-related process is in order.
Issue 8: Closed during the 6/11/2009 WG meeting; see transcript p. 51. TBDs updated in 2011.		
SC&A response – 01/05/2016: Concur – discussed on pp. 58–64 of the 6/11/2009 WG transcript. Cutting of DU beds took place in Milwaukee, not at Pinellas.		

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9	**The TBD fails to adequately define and assess occupational medical exposure.**	The current guidelines, as presented in Kathren and Shockley (2003), go a long way to assuring that all occupational medical exposures are reasonably included in determining the overall dose estimations for claimants. Unfortunately, the interpretation, to date, by the contractor, ORAU, has not been applied conservatively to be claimant favorable. The occupational medical dose TBD (ORAUT-TKBS-0029-3) assumes an interpretation, which also has been considered and applied at other sites, such as the Mound Plant, Los Alamos National Laboratory, and Paducah. To this extent, the assumption that medical procedures are limited to only one pre-employment chest x-ray and chest x-rays which are part of routine physical exams, may substantially underestimate worker medical exposure when evaluating occupational medical exposure. In more recent documentation, OTIB-0006, Revision 3 (Kathren and Shockley 2005), it is concluded that other examinations should be included, such as special screening exams (e.g., respiratory protection, beryllium workers, asbestos workers, etc.) and termination exams. The occupational medical TBD does not recognize this change from the previous Revision 2 of OTIB-0006, and also assumes that special chest radiography for respirator certification, beryllium and asbestos workers, and food handlers are accomplished as part of the routine physicals. This is not documented in the medical TBD. Another factor not discussed in the TBD is the potential and impact of x-ray procedures utilized by medical authorities to do special screenings that are performed outside the frequency suggested in the TBD. The TBD (ORAUT-TKBS-0029-3) makes the conclusion that chest examinations are often quite limited after 1974, after which kidney, ureter, and bladder (KUB) x-rays were no longer taken in addition to chest x-rays. It is suggested the policy was every 5 years before age 40, and every 3 years after age 40, but nothing is documented. To the contrary, there is ample evidence that chest x-rays were often provided on a voluntary basis to nearly all workers, usually on an annual basis. The majority of workers had chest x-rays as a routine at DOE sites until the mid-1980s, when federal guidelines warning against routine screening were first being enforced. After discussion with NIOSH personnel, it was their decision to limit occupational medical exposure to those chest exams described above, and to conclude all other exposure as part of worker background. SC&A believes such an interpretation is not claimant favorable to those most at risk. Our concern is that specified “high-risk” workers, those most likely exposed to radiation and beryllium, would be at risk of having an incomplete dose assessment, if not all radiation associated with medical screening for job-related activities were included. Since all radiation provides some risk, and arguably is cumulative, workers warrant consideration of all forms of work-related x-ray exposure to be claimant favorable. SC&A believes NIOSH should review its interpretation of included medical exposure, and should reasonably adopt a broader interpretation of occupational medical dose, as provided in the most recent version of the OTIB (Kathren and Shockley 2005).

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Issues 9, 10, and 11: Closed at the 6/11/2009 WG meeting; see transcript pp. 64–68. TBDs updated in 2011.		
SC&A response – 01/05/2016: Concur. Actually closed out at the November 19, 2012, WG teleconference. See transcript p. 54. Related to SC&A's review of the TBD-3 revision. That revision was not available until after the October 2011 WG meeting. SC&A's subsequent review of the TBD-3 revision closed out Findings 9–11 and Secondary Finding 1 from the original issues matrix, all of which were related to TBD-3.		
10	**Techniques and protocols increase uncertainty of DCFs listed in the TBD.**	The TBD in Section 3.2 fails to describe adequately all the information upon which to establish beam quality for x-ray units in use from 1957 to 1997. In 1972, the site documented installation of a single phase GE 225 unit. There is only limited documentation to show that the GE 225 unit, in use from 1972 through 1997, had added filtration; approximately 3.5 mm of aluminum (Al), as first measured by the Pinellas Health Department in 1972. In the absence of definitive tube output measurements, the TBD directs the use of default values and dose conversion factors (DCFs) derived from ICRP Report No. 34 (ICRP 1982). These values are then applied to determine organ doses using Tables A.2 through A.8 of ICRP Report No. 34 (ICRP 1982). An issue of concern is that the DCFs are derived using a default half value layer (HVL) of 2.5 mm Al for Type 1 units, in use from 1946 to 1980. The occupational medical TBD (ORAUT-TKBS-0029-3) provides little documentation to support the assumed techniques and protocols applied to calculate the dose, which is mainly derived from NCRP Report 102. The TBD states that a posterior-anterior (PA) chest x-ray was typically the only view. An undocumented assumption in the TBD is that exams required only a PA view. SC&A has inquired whether definitive protocols existed to validate that chest exams included PA views and LAT views, only on a limited basis after 1974. NIOSH has acknowledged in other TBD reviews that the lack of verifiable protocols is a generic problem at many sites, has planned to search all available records, and will include pertinent records and references in any future revision of this section of the TBD. The occupational medical TBD is also deficient, in that little documentation exists to validate x-ray protocols, equipment maintenance, and upkeep records prior to 1972.
Issues 9, 10, and 11: Closed at the 6/11/2009 WG meeting; see transcript pp. 64–68. TBDs updated in 2011.		
SC&A response – 01/05/2016: Concur. See response to Issue 9.		

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11	**Frequency and type of x-ray exposure is uncertain.**	The occupational medical TBD relies on a very limited review of archived medical records to establish frequency assumptions. The assumption of one chest radiograph (PA) every 3 to 5 years is not reasonably conservative, in that workers could essentially request an x-ray, or be subject to special screening exams. The frequency of screenings, and number and type of workers receiving x-rays does vary from site to site. The occupational medical TBD in Section 3.2 provides no documentation or references to support the assumption that only a limited group of workers received x-ray exams more frequently than every 5 years after 1974. To the contrary, up until about 1985, most DOE sites performed chest x-rays almost on a voluntary basis. DOE medical program reviews documented, during the early 1990s, showed many sites still used chest radiography as a general screening exam. Most workers accepted chest x-rays, even though the job did not require it. Also, the assumption that workers in special exposure categories, such as beryllium workers, were given chest x-rays only as part of their routine physical is not well documented and not consistent with special screening guidelines. The TBD applies no conservative assumption to cover such exams. The occupational medical TBD in Section 3.2 states that photofluorography (PFG) units, although generally available up to the late 1950s at most DOE sites, were not documented as being used at the Pinellas Plant. The undocumented absence of PFG units at Pinellas clearly has significant dose implications to workers who may have been given much higher doses from PFG units. The PFG unit provides a dose to the worker greater by a factor of 5–6, more than that delivered by conventional radiography. The TBD does not provide documentation for the types of equipment in use at Pinellas prior to 1972. SC&A believes it is not claimant favorable to instruct dose assessors to assume only PFG unit use from 1957–1960. To be fully claimant favorable, it would be appropriate to instruct dose assessors to use an annual dose of 3.0 rem per year for chest radiographs, in accordance with guidelines set forth (Kathren 2005) until the review of medical records evidenced no further use of a PFG unit at Pinellas.
Issues 9, 10, and 11: Closed at the 6/11/2009 WG meeting; see transcript pp. 64–68. TBDs updated in 2011.		
SC&A response – 01/05/2016: Concur. See response to Issue 9.		

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Secondary Issue 1	**Additional factors contribute to uncertainties related to occupational medical exposures.**	The occupational medical dose TBD (ORAUT-TKBS-0029-3) does not consider dose impacts due to less than optimal use of technology, such as using screens, grids, or bucky systems. The TBD does not consider these elements as potential contributions to uncertainty. The TBD does consider the potential contribution to dose that may have resulted in less than optimal use of collimation, at least prior to 1972, as stated in Section 3.3.2 of the TBD. Unresolved is the concern that the DCFs are derived from ICRP (1982), and therefore are not comparable in terms of beam quality, which varies from unit to unit. These factors can contribute greatly to the dose to the chest and other organs; for the unit in other TBDs in operation prior to 1997, little or no documentation exists. NIOSH has indicated in other TBDs that it will continue to search for other available records to better define equipment use and beam quality, and include it as appropriate in an updated version of the TBD. Uncertainty is defined in the TBD as being due to measurement error and variation in kilovoltage, tube current, timers, and the skin-to-surface distance (SSD). This approach is quite similar to the uncertainty analyses documented in other DOE site profiles. The conclusion in this TBD and others is that dose reconstructors for exposure prior to 1997 should use an uncertainty factor of +30%. SC&A believes the uncertainty correction factor of 2.0 being applied at other sites is more appropriate for use. SC&A agrees that the TBD conservatively estimates these essential aspects of an uncertainty review. Unresolved is the contribution to uncertainty in dose, due to other errors introduced by lack of quality controls in processing equipment and lack of adherence to established Standard Operating Procedures. A reasonable estimate of these contributions to uncertainty would be an evaluation of retake rates per examination type. NIOSH should revisit the potential for significant retake rates and evaluate its potential effect on dose as part of future revisions of this TBD, especially as it relates to prior to 1972. The occupational medical dose TBD does not show that Pinellas applied dose minimization principles to reduce medical exposures. The document also does not assess or consider the likely exposure to workers who are referred to offsite medical facilities for follow-up. The TBD states that review of selected medical records and files did not reasonably show or match expected x-ray exam frequency and type of exam, as shown in Table 3.1.1. Little evidence exists to document the number of x-ray exams provided to the average worker, or for special exposure needs.
Secondary Issue 1: See Issues 9 and 11. This secondary issue was completed with the disposition of the primary issues.		
SC&A response – 01/05/2016: Concur. See response to Issue 9.		

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Secondary Issue 2	**Inadequate descriptions for certain plant operations.**	The site description TBD, ORAUT-TKBS-0029-2, provides information on plant operations as they relate to understanding the source and relative magnitude of radionuclide doses. The information is sufficiently complete in the case of operations involving tritium, krypton, and plutonium. The TBD inadequately describes operations involving Ni-63, C-14, and particularly DU and metal tritides. The TBD should be revised to provide the reader with a greater understanding of processes utilizing the indicated nuclides.
Secondary Issue 2: See Issue 7. This secondary issue was completed with the disposition of the primary issues.		
SC&A response – 01/05/2016: Concur. Ni-63 and C-14 aspects in abeyance as of 06/11/09 pending addition of new information to the TBD. Incorporated into TBD-5, Revision 1 (Apr 2011). DU issue closed – no longer relevant (see Finding 8).		
Secondary Issue 3	**Perimeter tritium monitoring stations.**	Tritium air monitoring stations were operated on the perimeter of the site for a major part of the plant operating history. Up to six samplers were continuously operated and collected samples for determining tritium gas and oxide airborne concentrations. The existence of these stations is not mentioned in ORAUT-TKBS-0029-4. This is a missed opportunity to verify the modeling results by comparing them to measured values.
Secondary Issue 3: This secondary issue was closed during the June 11, 2008, WG meeting.		
SC&A response – 01/05/2016: Concur. Discussion on 6/11/08, transcript pp. 127–131. Information provided in Section 4.4.1 of TBD-4, Revision 01 (7/15/2011).		
Secondary Issue 4	**Inadequacy of ORAUT-TKBS-0029-4, Section 4.4 – Uncertainty.**	This section is inadequate and needs to be reworked to more adequately address the topic it is intended to discuss, i.e., uncertainty. The discussion in this section centers on factors that affect the quantity of dose calculated, and not the uncertainty associated with estimates. While it may not be possible to quantify the uncertainty of estimated doses, a more relevant discussion on the relative magnitude and factors affecting uncertainty is needed.
Secondary Issue 4: This secondary issue was completed with the completion of the primary issues.		
SC&A response – 01/05/2016: Concur. Discussed pp. 131–132 of 6/11/2008 transcript. More information provided in TBD-4, Revision 01, Section 4.5.		

Issue No.	Issue	SC&A Statement
Secondary Issue 5	**Rejection of plutonium bioassay results based on plutonium-238-to-plutonium-239 ratios, and non-detectable plutonium-239.**	In ORAUT-TKBS-0029-5, two conditions for rejection of a positive plutonium bioassay result as follows: *The ratio of ^{238}Pu to ^{239}Pu in a bioassay sample must be about 5:1 (±20%) or ^{238}Pu is detected while ^{239}Pu is not detectable.* The meaning of "(±20%)" in this statement is not clear. Does it mean the range of ratios to be rejected is from 4 to 6? This inclusion needs further explanation. The application of these criteria to plutonium bioassay results for the 3 years discussed in the TBD (1988, 1989, and 1990) was responsible for approximately 30% of the samples being designated as non-positive. The high degree of uncertainty associated with alpha spectrometry results at the levels of Pu-238 expected in bioassay samples makes the use of such a ratio as a reason for rejecting a positive Pu-238 questionable. These results should be reviewed on an individual basis, in that the use of this criterion, because of the relatively large uncertainties associated with values near the detection limits for plutonium, could result in the rejection of positive Pu-238 results. At a minimum, this would have prevented an investigation into the circumstances that could have led to the positive result.
Secondary Issue 5: See Issue 3. This secondary issue was completed with the disposition of the primary issues.		
SC&A response – 01/05/2016: Concur.		
Secondary Issue 6	**Plutonium solubility.**	In ORAUT-TKBS-0029-5, page 16, the following statement is made: *ICRP Publication 68 lists plutonium oxides as absorption type S (ICRP 1995, p. 83). A discussion of absorption type for plutonium oxides in ICRP 71 indicates that bioassay data from accidentally exposed workers to $^{238}PuO_2$ could have been closer to type M (ICRP 1996, p. 329).* Page 329 of ICRP 71 (ICRP 1996) also states that plutonium can have different lung clearance characteristics when inhaled as mixed metal oxide. The extent of increased dissolution/clearance depends on the metal and the relative proportions of plutonium to metal. Since there is an uncertainty on the definition of the solubility rates for Pu-238, and there is no clear definition of the solubility of the handled compound, the selection of the type of compound for dose reconstruction should be the one that is more claimant favorable. For some scenarios, the selection of Type M compound is not the claimant-favorable approach**.**
Secondary Issue 6: This secondary issue was completed with the completion of the primary issues.		
SC&A response – 01/05/2016: Concur.		

Issue No.	Issue	SC&A Statement
Secondary Issue 7	**Assumptions relative to unmonitored workers.**	ORAUT-TKBS-0029-6, Section 6.4.1, contains the following statement: *The analysis assumed that unmonitored (i.e., nonradiation) workers did not receive a significant dose compared to monitored workers; therefore, assigning a photon dose distribution for each year based on the dose received by monitored workers would ensure a claimant-favorable estimate of any unmonitored worker dose. Based on the review of the available dosimetry data, employees with any significant potential for external dose exposure appear to have been routinely monitored, as evidenced by the large number of monitored individuals that routinely had doses below the reporting levels. Therefore, it is reasonable to assume that unmonitored workers received less dose than monitored workers at the Pinellas Plant.* The fact that a large number of monitored individuals routinely had doses below reporting levels may give some level of comfort that workers with a significant potential for external dose were adequately monitored, but it is not proof. Neither does it lead to the automatic conclusion that unmonitored workers received less dose than monitored workers. These assumptions may be true but can only be verified if there is reasonable certainty that unmonitored workers were not subjected to different exposure potential or conditions than monitored workers. For example, unmonitored maintenance and janitorial personnel could be exposed during routine maintenance, waste removal, and cleaning operations to levels that exceeded those of operational personnel.
Secondary Issue 7: See Issue 4. This secondary issue was completed with the disposition of the primary issues.		
SC&A response – 01/05/2016: Concur.		
Secondary Issue 8	**Assumptions relative to minimum detectable level adjustments to dosimetry for missed dose.**	In Section 6.4.1.1, ORAUT-TKBS-0029-6, the following statement is made: *Missed dose is primarily estimated on dosimeter results n (the number of zero or < MDL values) multiplied by MDL/2. The MDL is particularly important during the early years of operation, when MDLs were probably higher and the dosimeter exchange rate was monthly rather than quarterly. One option to estimate a claimant-favorable maximum potential dose is to multiply the MDL by the number of zero dose results. This will provide an estimate of the maximum missed dose to the worker. The following sections consider missed photon dose for dosimeter results less than the MDL according to facility or location, dosimeter type, year, and energy range.* It is not clear from this discussion which approach was taken to adjusting dosimeter results in the analyses and Table 6-11, following this statement. A definitive statement indicating the selected approach should be made in this TBD.

Issue No.	Issue	SC&A Statement
Secondary Issue 8: This secondary issue was completed with the disposition of the primary issues.		
SC&A response – 01/05/2016: Closed – language clarified in Section 6.4 of TBD-6, Revision 1.		