Pinellas Plutonium Bioassay Data: *Response to the follow-up of Issue 3*
from the June 11, 2008 Working Group Meeting

During the June 11, 2008 Pinellas Working Group (WG) meeting, the issue listed below was discussed. As requested during the meeting, the National Institute for Occupational Safety and Health (NIOSH) provided a brief response to Finding 3 while awaiting the SC&A white paper entitled *Review of Pinellas Plutonium Bioassay Data*, which was dated December 2008. SC&A concluded that "there are sufficient reasons to question the quality of the plutonium bioassay data from the Pinellas Plant. In particular, the calculations of the MDCs are questionable and worthy of a more detailed examination. NIOSH should perform such an examination and revise the information contained in Table 5-1 of ORAUT-TKBS-0029-5 accordingly. Furthermore, the full impact of rejecting the otherwise positive Pu bioassay results based after 1988 on the activity ratio criterion should be evaluated." The purpose of this NIOSH document is to review the information presented and respond to the SC&A paper.

> ***Finding 3: MDCs and uncertainties for plutonium and bioassay measurements are inadequately addressed (ORAUT-TKBS-0029-5)***
>
> *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.*
>
> *There are several factors that may influence the uncertainties and the minimum detectable concentration (MDC) of the bioassay measurements. The parameters of the MDC equation 5-1 on page 6, assigned as TREVA (T = count time, R = recovery fraction, E = average detector efficiency, V = sample volume (L), and A = the alpha abundance for the radionuclide in question), have an important influence on the MDC value. The recovery is strongly dependent on the several factors related to the analysis of each sample, such as digestion of organic material of the sample, composition of the samples, reagents, and care in the preparation of the sample. The volume of the urine samples may not be correspondent to the 24-hour excretion rate.*
>
> *The average MDC value is an important parameter for the calculation of the missed dose, mainly because for plutonium the frequency of the routine bioassay program was annual. According to data presented in Table 5-1 (page 9/31), in 1980, the average MDC value for Pu-238 is 6.23E-11 uCi/mL and the maximum MDC value is 3.17E-10 uCi/mL; and the average MDC value for Pu-239 is 3.41E-11 uCi/mL and the maximum MDC value is 1.90E-10 uCi/mL. There is a factor of 5 between the average MDC value and the maximum value.*

NIOSH has performed an extensive review of the Pu bioassay data and the claims database. Currently, there are no claims associated with the bioassay data available for SC&A review. Pinellas documentation on the 1988 Pu bioassay results (SRDB Reference 12743 [PDN 240001295]) indicates that Pinellas did not experience loose surface or airborne Pu since the RTG Pu sources arrived at the site. Additionally, NIOSH could find no records indicating that Pu contamination was ever present at the site. The data discussed herein, does not include the Pu bioassay taken in 1975. These bioassay predate the RTG program and were collected during a period when there was no Pu source term present at Pinellas.

As can be seen in the table below, there is very little data available to base conclusions. Of the 12 recorded samples with potentially positive Pu results, 5 were "pre-employment" samples – samples taken before the worker performed any RTG work. There was no record of follow-up sampling conducted for the "pre-employment" samples. These types of samples are not indicative of exposure; rather, they are a baseline sample to be used as a reference point for later bioassay. These samples are 88B52, 88B53, 88B55, 88B56, and 89B99.

Seven of the potentially positive Pu samples analyzed contained only Pu-239/240, four of which were included in the group of "pre-employment" samples. Four of the "pre-employment" samples and 4 others were part of this group. These samples would normally be discounted because the ratio of Pu-238 to Pu-239 excludes the sample because it does not follow the Pu-238 to Pu-239/240 ratio of 822:1 (that is associated with the RTG sources). As discussed during the June 11, 2008 WG meeting, the text of the TBD discussing the Pu ratio was incorrect. The TBD quoted criteria published by Pinellas and provided no criteria for use during NIOSH dose reconstruction. Discounting samples, using the appropriate ratios, is a valid method. The samples excluded as being "pre-employment", or outside the ratio, include all of the samples identified in the table below, except samples: 88B49, 88B50, 88B61, and 90B112.

Summary of Positive Pu Urine Sample Results for the Pinellas Plant

Bioassay Year	Sample Number	Pu-238 Only	Categories for Discounting Positive Results				
			1st Bioassay Only[a]	Pu Ratio Not Close to 822:1[b]	Pu-239/240 Only[c]	Reanalysis Results <MDC[d]	Lower Bound <MDC[e]
1988	88B49	X					X
1988	88B50			X		X	X
1988	88B52		X		X		
1988	88B53		X		X		X
1988	88B55	X	X			X	X
1988	88B56		X		X		X
1988	88B57				X		X
1988	88B58				X		X
1988	88B59				X		X
1988	88B61[f]	X				X	
1989	89B99		X		X		X
1990	90B112	X					X

Notes:

a - Indicates that this was the 1st bioassay measurement for the worker, which was a pre-operational sample.

b - Both Pu-238 and Pu-239/240 were detected, but the Pu-238 to Pu-239/240 ratio was nowhere close to the ratio of 822:1 that would be associated with the RTG sources. Also, this category was only checked if both Pu-238 and Pu-239/240 were detected.

c - Because there is more Pu-238 in the RTG sources than Pu-239/240, it is impossible to have an intake of Pu-239/240 without an intake of Pu-238.

d - A reanalysis was performed on this urine sample and all of the reanalysis results were below their MDC values.

e - The lower bound of the sample result (i.e., the result minus the uncertainty value) was below the MDC, which indicates that the reported result was still potentially below the MDC.

f - One of the reasons that the original Pu-238 result was above the MDC was likely due to a Pu-242 tracer yield that was much lower than it should have been. Also, the tracer yield for the reanalysis was even worse making both sets of analysis results questionable.

The information provided with the 1988 Pu bioassay data (SRDB Reference 12743 [PDN 240001295]) indicates that positive results occurring in 1988 were likely due to changes in the plutonium analysis method. Starting with the analysis of the 1988 urine samples, new alpha spectrometry equipment was used and the counting procedures and data handling procedures were updated. Prior to 1988, an "alpha spec peak analysis method" was used, which only involved a 1 channel-centroid determination for the Pu-238 and Pu-239/240 results. The new analysis method involved a region of interest activity method that was used along with a multi-channel analyzer. The new method should have also resulted in lower MDAs and better counting statistics, because more channels and thus more counts were being used to calculate the sample results. However, for some reason the new method appears to have had little impact on the analysis MDAs. One potential reason for this is that the site may have used the new method to reduce its count times, but there is no record available for count times.

NIOSH has not used the criteria that Pinellas published for discounting Pu bioassay results above their reported MDCs. Additionally, NIOSH has not encountered any potentially positive Pu bioassay results in any of the claims that have been completed to date.

NIOSH agrees with SC&A that the quality of bioassay data from Pinellas is questionable, given the limited amount of data available and the obvious problems with the 1988 data. However, there are no bioassay samples after 1988 that are discounted for the ratio stated in the SC&A paper. Because of the questionable Pu bioassay results and because of the lack of a reasonable source term (i.e., if there is no dispersible Pu available, there is no likelihood of internal exposure), NIOSH plans to approach this Pu bioassay on a case-by-case basis. If there is a likelihood of exposure, then dose will be calculated using either the MDCs from similar programs or the MDCs reported for the Pinellas bioassay results, whichever is more claimant-favorable. Based on that methodology, potential internal Pu doses would only be assessed for the RTG workers involved with performing the receipt inspections survey performed on the RTG Pu sources and/or those involved with decontaminating any contaminated RTG Pu sources. The only known possibility of dispersible Pu was during the receipt of the RTG Pu sources.