



DEPARTMENT OF HEALTH & HUMAN SERVICES

## Memorandum

**To:** Pinellas Plant Working Group

**From:** Peter Darnell, DCAS Health Physicist  
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**Subject:** Response to SC&A Memorandum on Matrix Issue #5: Gamma LOD for RTG Pu-238 Generators

**Date:** March 2, 2016

The following discussion responds to SC&A's February 3, 2016 comments on Matrix Issue #5: Gamma LOD for RTG Pu-238 Generators. The original SC&A comment was:

*Remaining open sub-issue was the basis for the LOD of 10 mrem for the post-1974 period in Table 6-9 of TBD-6 instead of 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 12/7/2015, I asked Joe Zlotnicki (SC&A, former VP 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. SC&A is still looking into this and will be prepared to discuss at the February 2016 WG meeting.*

The first NIOSH response referenced several SRDB files in support of an LOD of 10 mrem and recommended no change to the LOD. Since that time, SC&A issued a second memorandum outlining their conclusion that the LOD should be 20 mrem based upon information from the National Aeronautics and Space Administration (NASA). Primarily, SC&A pointed out the photon flux spectrum is from photon energies >800 KeV (refer to the NASA report table 4.16). Higher photon flux spectrum corresponds to aged fuel for the RTG.

On Friday, February 26, the historical detection limit of Landauer film badges was discussed in a technical call with Dr. Craig Yoder of Landauer, with representatives of NIOSH, SC&A, and the Advisory Board participating in the call. Dr. Yoder confirmed that, while the response of film is energy dependent, Landauer film badges over the 1970s time period in question could measure high energy doses in the 10 mrem range. Landauer's normal practice was to round measured results to the nearest 10 mrem. Thus, any measurement greater than 10 but less than 15 mrem would be reported as 10. Likewise, any measured dose greater than 15 mrem but less than 20 would be reported as 20 mrem.

NIOSH has also examined the NASA report cited by SC&A. The report indicates (see section 4.1.4 page 54 of 191) that the photon energy spectrum varies significantly with the age of the Pu. The variance of the photon flux spectrum based upon the age of the RTG fuel is key to understanding RTG external doses. NIOSH agrees that aged fuel that was fully encapsulated would have had a photon flux spectrum predominantly consisting of energies greater than 250 keV. However, SRDB 12185 (PDF page 5 of 17) indicates that in 1988 95% of the Pinellas production inventory had an age of 1 year. The remaining production inventory had an age of 2 years. Data in Table 4-9 (PDF page 57 of 191) of the NASA report indicated a predominance of gamma emissions below 250 keV for fresh and 1-year aged RTG Pu-238 fuel. Pinellas employees handled fresh to 1 year old Pu-238 fuel. The full complement of shielding for the RTG capsule was not in place at Pinellas. In addition, data from Table 4-16 of the NASA report indicates that 70% of the total photon flux was below 200 keV.

In their memo, SC&A also refers to Systems Nuclear Auxiliary Power (SNAP) plutonium-238 (Pu-238) RTGs. According to the NASA document (see page 64 of 191), the SNAP-27 RTGs are 15.6 inches long and have an outside diameter of 2.519 inches. Figure 6-1 of SRDB 13264 indicates that the Pinellas RTGs are approximately 1 inch by 1 inch and SRDB 9971 discusses "thimble sized" RTGs. The dose rate from the SNAP-27 RTG ranges from 25 to 35 mrem/hour at 20 inches while the Pinellas RTG measured 0.18 mrem/hour (see ORAUT-TKBS-0029-6 page 27 of 59).

In conclusion, NIOSH believes that the use of 10 mrem as a detection limit for Landauer film badges at the Pinellas Plant is appropriate. NIOSH also reviewed the NASA document referenced in SC&A's comment on matrix issue 5. Our review indicates that the photon energy spectrum emitted by Pu-238 SNAP sources in the NASA document is probably not a reasonable surrogate for the energy spectrum emitted by the small heat sources that were assembled at Pinellas.

Sincerely,

[Signature on File]

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