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SC&A Response to Pinellas Plant Issues Raised at the January 29, 2026, Work Group Meeting

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Prepared by

Stephen L. Ostrow, PhD
Ron Buchanan, PhD, Certified Health Physicist (CHP)
Rose Gogliotti, MS

SC&A, Inc.
2200 Wilson Blvd., Suite 300
Arlington, VA 22201-3324

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Abbreviations and Acronyms

α	alpha particle
ABRWH, Board	Advisory Board on Radiation and Worker Health
ALARA	as low as reasonably achievable
Am	americium
Am-Be	americium-beryllium
Am-Li	americium-lithium
ANS	American Nuclear Society
ANSI	American National Standards Institute
APNEA	Active/Passive Neutron Examination and Assay (system)
APR	Authorized Petitioner Representative
β	beta particle
C	carbon
CATI	computer-assisted telephone interview
CDC	Centers for Disease Control and Prevention
Cf	californium
CHP	Certified Health Physicist
Ci	curie
Ci/g	curies per gram
Ci/kg	curies per kilogram
cm	centimeter
Co	cobalt
CRAF	Comet Rendezvous-Asteroid Flyby
Cs	cesium
DCAS	Division of Compensation Analysis and Support
DISR	Descent Imager/Spectral Radiometer
DOE	U.S. Department of Energy
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation
DU	depleted uranium
EBR	Environmental Baseline Report
EMP	external matrix probe
ER	petition evaluation report

ERDA	U.S. Energy Research and Development Administration
ESA	European Space Agency
FY	fiscal year
g	gram
GE	General Electric Company
GEND	General Electric Company Neutron Devices
GPHS	general purpose heat source
GPHS-RTG	General Purpose Heat Source – Radioisotope Thermoelectric Generator
HASL	U.S. Atomic Energy Commission Health and Safety Laboratory
HRS	(State of Florida Department of) Health and Rehabilitative Services
HT	tritium gas
HTO	tritiated water
H-3	tritium
IT/RSL	IT Corporation/Radiological Sciences Laboratory
keV	kiloelectron volt
kg	kilogram
Kr	krypton
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
LMSC	Lockheed Martin Specialty Components
μCi	microcurie
μCi/ml	microcuries per milliliter
μCi/g	microcuries per gram
m	mass
MDL	minimum detectable level
MeV	mega-electron volt
mm^3	cubic millimeters
mrem	millirem
mrem/hr	millirem per hour
mrem/yr	mrem per year
MSDS	Material Safety Data Sheet
MT	metal tritide
n/s	neutrons per second

NASA	National Aeronautics and Space Administration
Ni	nickel
NIOSH	National Institute for Occupational Safety and Health
NNDC	National Nuclear Data Center
NRC	U.S. Nuclear Regulatory Commission
OBT	organically bound tritium
ORAU	Oak Ridge Associated Universities
ORAUT	Oak Ridge Associated Universities Team
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
OSTI	DOE Office of Scientific and Technical Information
OTIB	ORAUT technical information bulletin
Pa	protactinium
PAL	permissive action link
PP	Pinellas Plant
PPE	personal protective equipment
Pu	plutonium
Pu-Be	plutonium-beryllium
Pu-238O_2	plutonium dioxide
PuO_2	plutonium dioxide
rem	roentgen equivalent man (a unit of radiation dose)
RTG	radioisotope thermoelectric generator
sec	second
SEC	Special Exposure Cohort
SF	spontaneous fission
SNAP	Systems for Nuclear Auxiliary Power (generator)
SNM	special nuclear material
SRDB	Site Research Database
SRS	Savannah River Site
TBD	technical basis document
TIG	tungsten inert gas
TRU	transuranic
U	uranium

UO_2	uranium dioxide
U_3O_8	uranium oxide
WB	whole body
WG	work group
WSJ	*Wall Street Journal*
Wt%	weight percent

1 Introduction and Background

The Pinellas Work Group (WG) and the petitioners have raised several issues related to whether any consequential personnel exposures to plutonium, uranium, or other radioisotopes have been overlooked in the National Institute for Occupational Safety and Health (NIOSH) and SC&A documents and during WG discussions. This report responds specifically to the Authorized Petitioner Representative's (APR's) weight of evidence paper (APR, 2026a) submitted to the Pinellas WG on January 14, 2026, prior to the WG's meeting on January 29, 2026. The APR also delivered an accompanying slide presentation at that meeting (APR, 2026b). Note that NIOSH responded to APR (2026a) in NIOSH (2026).

APR (2026a) appears intended to reinforce the APR's long-standing position—expressed in prior submissions to the WG—that the NIOSH Special Exposure Cohort (SEC)-00256 petition evaluation report (NIOSH, 2021) does not sufficiently demonstrate NIOSH's ability to reconstruct doses during the proposed SEC period. The paper reiterates several concerns and many of its topics that have already been examined in SC&A and NIOSH technical reviews and discussed in WG meetings.

This report responds comprehensively point-by-point to APR (2026a) and addresses associated material to clarify as needed. It introduces additional plutonium-related information because the APR paper's central claim is that unreported plutonium sources at Pinellas may have contributed significantly to worker exposures. Additionally, the last section of this report addresses other concerns raised by WG members at its January 29, 2026, meeting (ABRWH, 2026). SC&A notes that previous evaluations and discussions of methods and data have consistently supported the conclusion that dose reconstruction for the period in question can be performed with sufficient accuracy. This paper supports that conclusion. SC&A will continue to evaluate any additional material or concerns that might emerge subsequent to this report. (Note: this report's closing date for examining new material was the end of May 2026.)

2 "Weight of Evidence" Paper

The introductory paragraph of APR (2026a) acknowledges that tritium was the primary radionuclide of concern throughout the operation period. Tritium was used in various processes associated with the manufacture of neutron generators. The paragraph states there are adequate tritium monitoring data (20,000 tritium bioassay results for 230 individuals) to bound doses from tritium. The remainder of the paper introduces potential additional radiological source terms and details of some of the processes. The paper claims that some of the source terms have not been adequately characterized.

SC&A agrees with the tritium statement and will examine claims in the APR paper (2026a) about "additional radiological source terms and additional details of some of the Pinellas Plant processes" (PDF p. 3). SC&A notes the interim review report (SC&A, 2023) and the supplemental review report (SC&A, 2025) have already addressed many of these concerns. APR (2026a) first treats plutonium issues, which will be addressed after a more general review of plutonium and the currently accepted plutonium situation at Pinellas.

2.1 Plutonium

Sections 2.1.1 and 2.1.2 of this report present, respectively, a general orientation of the nature and uses of plutonium and how plutonium was used at Pinellas. Section 2.1.3 responds specifically to APR (2026a) comments related to plutonium, and section 2.1.4 presents SC&A's conclusions concerning plutonium.

2.1.1 Plutonium review

According to the National Nuclear Data Center (NNDC, located at Brookhaven National Laboratory) plutonium has 27 isotopes ranging from plutonium (Pu)-221 to Pu-247, none of which are stable. Table 1 shows the half-lives and decay modes of the most common isotopes (NNDC, 2026). As can be seen, the overwhelmingly predominant decay mode is through alpha (α) particle emission, except for the almost pure beta (β) particle emission of Pu-241.

Table 1. Nuclear data for selected plutonium isotopes

Isotope	Half life	Decay mode	Predominant alpha energies and intensities
Pu-238	87.7 years	α = 100%, spontaneous fission (SF) = 1.9×10^{-7}%	5.50 mega-electron volts (Mev) (71%), 5.46 MeV (29%)
Pu-239	24,109 years	α = 100%, SF = 3.01×10^{-10}%	5.2 MeV (70.8%), 5.1 MeV (29.2%)
Pu-240	6,562 years	α = 100%, SF = 5.8×10^{-6}%	5.17 MeV (72.8%), 5.12 MeV (27.1 MeV)
Pu-241	14.3 years	α = 2.45×10^{-3}%, β = 99.998%	Very low α intensities
Pu-242	3.750×10^{5} years	α = 100%, SF = 5.5×10^{-4}%	4.9 MeV (99.9%)

Note: Data are taken from the "Decay Radiation" section of the NNDC (2026) listing for plutonium. To simplify this table, the energies and associated intensities were combined in some cases where there are very closely spaced alpha energies.

Pu-238 is commonly used as a heat source in radioisotope thermoelectric generators (RTGs), one of the main products at Pinellas. Pu-239 is fissile (fissionable by thermal energy neutrons) and is used as a fuel in certain nuclear reactors as well as in nuclear weapons. Pu-240 is formed by neutron capture by Pu-239 and is fissionable (by high-energy neutrons) but not fissile. Pu-241 is fissile (but not feasible for use in a nuclear reactor for several technical and cost reasons) and is formed by neutron capture by Pu-240. Pu-242 is fissionable and formed by neutron capture by Pu-241. Pu-238 and Pu-239 are the only two plutonium isotopes with significant applications. In addition to their primary radiations listed in table 1, all the isotopes undergo some small degree of spontaneous fission and may emit low-energy x-rays as well.

Pu-238 has been used for many decades as a favorite heat source in RTGs for both space and terrestrial use for several reasons summarized in U.S. Department of Energy (DOE) (2008, p. 3):

- long half-life of 87.7 years
- high specific power of 0.57 watts per gram (g)
- low radiation levels since it is primarily an alpha emitter
- high thermal stability in oxide form
- low solubility rate in human body and environment

The availability of the other plutonium isotopes is much too limited or very restricted (i.e., Pu-239) to make them useful.

2.1.2 Plutonium at Pinellas

This section reviews the reported sources of plutonium at Pinellas as well as several former SC&A investigations. Plutonium, in the form of plutonium dioxide (PuO_2), was present at Pinellas as a heat source for the RTGs produced in Building 400 from 1975 to 1991. The heat sources themselves were manufactured at Los Alamos National Laboratory (LANL) in a sealed, triply encapsulated configuration and shipped to Pinellas for assembly into complete RTGs. A 1982 DOE safety analysis report in support of a planned expansion of Building 400 (DOE, 1982) describes in detail the form, handling, and plutonium operations at Pinellas. The report describes an RTG as follows:

> An RTG consists of a heat source containing a small amount of plutonium oxide encapsulated in a thimble-sized container. The heat source is enclosed within thermal insulating material so that its temperature approaches 500°C [degrees Celsius]. It is mated with a thermopile consisting of many thermocouples connected electrically in series and thermally in parallel between this high temperature source of heat and the relatively cool outer case. The temperature differential causes heat to flow through the thermopile which the latter converts to electrical energy. . . . The current design produces 25 milliwatts of electrical power at two volts for in excess of 25 years. [DOE, 1982, PDF p. 3]

The DOE report notes that "three layers of encapsulation contain the source material. . . . The outer layer is a nickel alloy and the inner two layers are a tantalum alloy" (DOE, 1982, PDF p. 40). The RTG design, manufacturing, and handling controls' "effectiveness can be demonstrated by the fact that there is not, nor has there ever been, any plutonium contamination inside the facility nor released to the environment" (PDF p. 6). The report concludes that "the probability of source leakage, although possible, is so small that it can be assumed that it will not occur" (PDF p. 45).

Documents from Pinellas and other sources consistently state that it is extremely unlikely for plutonium to escape from the plant's triply encapsulated heat sources. In addition to regularly monitoring and testing for plutonium, Pinellas contracted with IT Corporation/Radiological Sciences Laboratory (IT/RSL) to evaluate air monitoring systems at the plant. (Presumably, any plutonium found off site originating from the plant would first have to become airborne and go up the stack.) IT/RSL's air monitoring systems evaluation resulted in a report (IT/RSL, 1986). The Oak Ridge Associated Universities Team (ORAUT) Pinellas environmental dose technical basis document (TBD), ORAUT-TKBS-0029-4, revision 01 (ORAUT, 2011a), cites the IT/RSL (1986) report. The TBD states, "Encapsulated sources of plutonium were also present at the [Pinellas] Plant in significant quantities, but a review of the environmental monitoring reports for the site indicates that no plutonium was ever released to the environment" (ORAUT 2011a, p. 8). The TBD also notes that "although there were no reported plutonium releases at the Pinellas Plant, airborne effluents from the Building 400 stack were sampled for plutonium using a continuous stack sampling system. Particulate air samples were collected on filters that were exchanged monthly and later analyzed for ^{238}Pu and $^{239/240}$Pu (IT/Radiological Sciences Laboratory, 1986)" (ORAUT, 2011, p. 11). A later section in the IT/RSL report describes the plutonium analysis methods and gives the minimum detection levels for ^{238}Pu and $^{239/240}$Pu sampling, which ranged from 5.9×10^{-19} to 3.7×10^{-18} microcurie per milliliter (µCi/mL) for ^{238}Pu and $^{239/240}$Pu (IT/RSL, 1986, p. 8).[1]

The IT/RSL report states, "Guidance for airborne effluent monitoring instrument performance is found in ANSI [American National Standards Institute] N13.10. Minimum levels of detectability for continuous monitoring of radionuclides in gaseous effluent streams are given for the radionuclides in use at the Pinellas Plant" (IT/RSL, 1986, p. 4). The minimum detectable level (MDL) is the same for both Pu-238 and Pu-239, 2×10^{-12} µCi/ml (p. 4); hence, the Pinellas MDLs are well below (i.e., better than) the ANSI guidance levels at that time. The IT/RSL report concluded, "The measurement systems in use for environmental sampling for airborne plutonium have sufficient sensitivity" (IT/RSL, 1986, p. 22).

The Pinellas SEC-00256 petition evaluation report (NIOSH, 2021) echoes the theme of dismissing the possibility of Pu releases:

> Starting in 1975, the Pinellas Plant monitored for plutonium because of the encapsulated plutonium related to the RTG operations conducted in Building 400 [[DOE, 1994a], PDF p. 60]. Pinellas performed stack sampling for airborne effluents from Building 400 using a continuous stack-sampling system. However, after reviewing the incident reports and the environmental monitoring reports for 1975–1990, NIOSH could not find any evidence of plutonium releases reported at the Pinellas Plant. [NIOSH, 2021, p. 54].

This finding of no plutonium releases led to the conclusion in the evaluation report that "an ambient environmental internal dose reconstruction methodology for plutonium is not necessary [Martin Marietta [1994], PDF p. 58; Martin Marietta [1995a], PDF pp. 29–30]" (NIOSH, 2021, p. 64).

SC&A revisited its previous plutonium-related reviews, which this report references as applicable. As part of its assessment of the evaluation report, SC&A examined all the available environmental monitoring data. SC&A reported in its interim review report (SC&A, 2023) that the data support NIOSH's conclusion that no plutonium was ever released from the plant and that any offsite plutonium measurements were due to fallout from nuclear weapons tests and not plant releases. The report quoted supporting evidence from the "First Plutonium Delivered Onsite" document:

> Fall-out plutonium has been detected at the Pinellas Plant, but analysis for releases of RTG plutonium focuses on the isotopic ratio of 80% by weight Pu-238 and 16% by weight Pu-239. Pu-238 and Pu-239 have not been found in these ratios in environmental samples, therefore, no releases from Pinellas Plant

[1] Harabagiu et al. (2021, p. 1) explains why Pu-239 and Pu-240 were often measured together: "Pu-239 and Pu-240 isotopes emit closely spaced (<10 keV separated) energetic alpha particles and constitute a known challenge to decipher without resort to microcalorimetry or mass spectroscopy."

> operations have been detected in the environment. (“First Plutonium,” n.d., PDF p. 2) [SC&A, 2023, pp. 29–30]

The SC&A interim review report concluded that the potential for plutonium intakes at the site has been adequately addressed and resolved, and subsequent reviews—including examination of additional data supplied by the APR—have not identified new information that would change that conclusion. The WG previously (ABRWH, 2011, 2016) determined that there is no credible pathway for internal plutonium exposure at Pinellas, and SC&A’s followup evaluations reaffirm that determination. Nonetheless, the WG and the APR continued their interest in the subject, which resulted in this current SC&A investigation and report.

SC&A followed up its interim review report with a supplemental review report 2 years later (SC&A, 2025). That report summarized SC&A’s activities since the first report, reviewed a large amount of material submitted by the APR, responded to areas of particular WG concern, and continued to identify and examine other relevant documents. The supplemental review report further examined the issue of potential plutonium releases. Observation 15 notes the following:

> After issuing the interim review report in June 2023, SC&A conducted further research using documents for transuranic radionuclide sampling. SC&A located urinalysis bioassays, air sampling, and environmental sampling for plutonium (Pu)-238 and Pu-239 during the plant’s operating period. SC&A analyzed the data from approximately 100 samples for indication of the potential for workers’ intakes above normal background exposures and fallout concentrations. This analysis did not indicate elevated sample levels coming out of the stack scrubbers, nor the uptake or the potential for uptake of plutonium or other transuranic radionuclides arising from plant operations. [SC&A, 2025 p. 9]

NIOSH (2025) responded to SC&A (2025) and stated in response to Observation 15, “NIOSH concurs. No response required” (NIOSH, 2025, p. 3).

To determine whether offsite measurements of plutonium were indicative of Pinellas Plant releases (a claim made in APR (2026a)), it is necessary to know what the isotopic ratios of the RTG plutonium were. The previously quoted “First Plutonium” reference stated 80 percent Pu-238 oxide and 16 percent Pu-239 oxide by weight (“First Plutonium,” n.d., PDF p. 2). Several sources, for example, the 1982 Pinellas Plant Environmental Monitoring Report (General Electric Company (GE), 1983), state that the plutonium isotopic composition of the RTGs produced at Pinellas were “approximately 80 percent plutonium-238 oxide and 20 percent plutonium-239 oxide” (GE, 1983, PDF p. 235). More precise numbers appear in the safety analysis report expansion of the Building 400 RTG facility (GE, 1982a, PDF p. 39), which gives the typical RTG plutonium heat source composition as 11.8 percent oxygen and 88.2 percent plutonium (80.2 percent of which is Pu-238).

GE (1991) contains several bioassay reports, the first of which (dated January 27, 1989), by a Pinellas Advanced Health Physicist, discusses 1988 bioassay results. The report states, “The typical plutonium composition of the heat sources [Oxygen 11.8 (Wt% [weight percent]) and Plutonium 88.2 (Wt%)] used at GEND [General Electric Company Neutron Devices] is Pu-238, 80.2 (Wt%) and Pu-239, 15.9 (Wt%). . . . During the last 15 years no plutonium activity has been detected in the air, on heat sources or on completed RTG units" (GE, 1991, PDF p. 3).

GE (1991) lists several criteria for determining if a positive plutonium bioassay result implies uptake from RTG operations, one of which is that "the [weight] ratio of Pu-238 to Pu-239 . . . must to [*sic*] be about 5 to 1 (± 20%) or Pu-238 is detected while Pu-239 is not detectable" (PDF p. 4). Results of 16 measurements are given, 10 of which have the comment "ratio not GEND" and the remaining 6 noted measurements "less than MDL" (PDF p. 5). The report concludes, "Using the stated criteria above, GEND's plutonium bioassay results for 1988 are not an indication for concern (also based on the fact that other monitoring methods do not indicate any plutonium contamination)" (PDF p. 5).

SC&A examined several other data sources to verify the composition of the RTG heat sources at Pinellas, a few of which are discussed here. Section 6.4 of SC&A's supplemental review report (SC&A, 2025) responded to a WG request to investigate the number of different RTG models produced at Pinellas. SC&A consulted a series of what it considers primary references, such as progress reports and other documents issued by LANL on the lab's Milliwatt Generator Project, which began in 1986 and ran for about 10 years. SC&A believes that three different plutonium heat sources, models MC2893, MC2893A, and MC3559, powered three different Pinellas RTG models, MC2730, MC2730A, and MC3500 (SC&A, 2025, p. 16). The referenced LANL Nuclear Materials Technology Division's "Actinide Research Quarterly" states, "The heat sources for milliwatt RTGs are identical except for the amount of plutonium oxide granules contained in the 4.0-watt and 4.5-watt [thermal] models" (LANL, 1994a, p. 3).

After confirming the identities of the plutonium heat source models used at Pinellas to connect them to the ones referenced by LANL, SC&A consulted other primary sources providing more detailed information, including heat source compositions. A Sandia National Laboratories report compiled several papers on RTG development work. One of these, O'Brien and Jones (1974), discusses the development of the MC2893 heat source for the MC2730 RTG (both identified as applicable to Pinellas) and states the Pu-238 percentage of the "plutonia":

> The MC2893 heat source (Fig. 1) incorporates 15 grams of PuO_2, generates 6 watts of thermal power, and operates at a nominal temperature of 425°C. The fuel is contained within three layers of encapsulation, each a deep-drawn cylinder with a flat end-cap TIG [tungsten inert gas] welded in place. The heat source is 2.3 cm [centimeters] in diameter and 2.3 cm long, and has a mass of 70 grams. . . . The fuel is plutonium dioxide (plutonia) enriched to 80% in the ^{238}Pu isotope. It is used in the form of ceramic shards [not powder] with a size range of 53 to 500 microns. [O'Brien & Jones, 1974, p. 34]

Another report (LANL, 1997) related to the LANL Milliwatt Generator Project compares in table III the plutonium isotopic contents (weight percent) of feed lots measured by the Savannah River Site (SRS) and LANL, showing close agreement between the two laboratories. Table 2 shows the comparison.

Table 2. Plutonium isotopic contents of feedstock for Savannah River Plant and Los Alamos National Laboratory

Isotope	Savannah River Plant, %	LANL, %
Pu-238	83.13 ± 0.12	83.09 ± 0.15
Pu-239	14.43 ± 0.10	14.44 ± 0.11
Pu-240	2.03 ± 0.04	2.04 ± 0.04
Pu-241	0.29 ± 0.01	0.30 ± 0.01
Pu-242	0.12 ± 0.01	0.13 ± 0.01

The Pu-238 83 percent value agrees with the approximately 80 percent given in other documents. The total of the other isotopes is about 17 percent, as expected. It is not conclusive, however, that the "feedstock" shown in table 2 did not undergo further processing before being turned into RTG heat source material.

The Pinellas Plant safety analysis report for expansion of Building 400, where RTGs were processed, lists a typical Pinellas RTG heat source composition as 11.8 Wt% oxygen and 88.2 Wt% plutonium (DOE, 1982, PDF p. 40). It then provides a breakdown of the plutonium isotopic content in more detail than appears elsewhere. That information appears here in table 3.

Table 3. Plutonium isotopic contents in Pinellas radioisotope thermoelectric generators

Isotope	Weight percent
Pu-236	0.00012
Pu-238	80.2
Pu-239	15.9
Pu-240	3.022
Pu-241	0.643
Pu-242	0.132

The safety analysis report (DOE, 1982, PDF p. 40) also lists typical actinide impurities in the heat source, shown here in table 4.

Table 4. Actinide impurities in Pinellas radioisotope thermoelectric generators

Isotope	Weight percent
Americium-241	0.0033
Neptunium-237	0.130
Uranium-234	0.140

Finally, DOE (1982) states that the total of other isotopic impurities, including protactinium (Pa)-231, thorium-232, uranium (U)-233, U-235, U-236, and actinium-237 comprises less than 1 Wt% of the RTG heat source. Although the DOE report lists percentages of all the plutonium isotopes in the RTG heat sources, the airborne plutonium detection system apparently only sampled for Pu-238 and Pu-239 content using alpha spectrometry:

> The environmental monitoring program for RTG operations consists of sampling the Building 400 exhaust stack effluent, on-site air and soil sampling and off-site air and soil sampling.

> The method of analyses for all sample types consists of (1) aliquoting, (2) introduction and chemical equilibration of a ^{242}Pu tracer for recovery efficiency determination, (3) acid digestion of the sample, (4) plutonium isolation by anion exchange, (5) electrodeposition and (6) alpha spectrometric analysis for ^{238}Pu and ^{239}Pu content. [DOE, 1982, PDF p. 64]

After consulting multiple sources of information about the isotopic composition of plutonium in Pinellas RTG heat sources, SC&A believes there is strong support for the assertion of the evaluation report and other NIOSH documents that the heat source material consisted of approximately 80 percent Pu-238 by weight, with the remainder consisting of Pu-239 and a mixture of other plutonium isotopes as well. This mixture would lower the Pu-239 percentage below 20 percent. This would not affect any conclusions reached about whether the offsite environmental plutonium measurements (discussed later in this report) indicate any release of plutonium from the plant.

2.1.3 Plutonium issues

This section focuses on responding to APR (2026a) concerns related to plutonium.

2.1.3.1 Plutonium-238

2.1.3.1.1 Pinellas plutonium inventory

The first section of APR (2026a) under the plutonium heading begins with the following:

> NIOSH has continually stated that Pinellas Plant for radioisotope-powered thermoelectric generator (RTG) heat source work, staff only worked with triply-encapsulated plutonium-238; and that the only Pu-239 was a 7g Pu-239 calibration source used for health physics monitoring equipment. [APR, 2026a, PDF p. 3]

SC&A's interim review report echoes the NIOSH assertion:

> An updated document in the Pinellas SRDB [Site Research Database] files elaborates that the first plutonium appeared at Pinellas on January 18, 1957, when a 7-gram Pu-239 calibration source was received (First Plutonium Delivered Onsite, n.d.). More importantly for this review, the "First Plutonium" document [PDF p. 2] discusses the chronology of the RTG operations as follows: "The first receipt of plutonium for use in the Radioisotope Thermoelectric Generator (RTG) was on November 4, 1975, when seven heat sources totaling 54.4 grams of Pu-238 were received from Sandia Laboratories," and "all plutonium, with the exception of calorimeter sources and small instrument calibration check sources, were removed from the plant in February 1991" [SC&A, 2023, pp. 28–29]

The site description TBD (ORAUT, 2011b), which references a Pinellas document (GE, 1982a), states that one model of the RTG heat sources contained 8.75 g of plutonium and another, 10 g. Therefore, the seven heat sources received in 1975 would have contained a total of from 61.3 to 87.5 g plutonium depending on the mix of heat sources models. Since the sources contained about 80 percent Pu-238, the total range of Pu-238 content would be from about 49 to 70 g. The "First Plutonium" reference of 54.4 g Pu-238 for seven heat sources is well within that range, appears plausible, and does not suggest that the Pu-238 was present in any form other than encapsulated within an RTG heat source.

APR (2026a) continues as follows:

> However, two unaccounted shipments of Pu-238, totaling **91.4938 kg** [kilograms], were shipped from Mound to Pinellas Plant. Pinellas Plant has no record of these shipments, nor does it identify any projects or work for which it was used. What were those shipments used for? Why is there no accountability for that material? [APR, 2026a, PDF p. 3; emphasis added]

SC&A examined the three references cited in the APR's paper claiming two shipments of Pu-238 from Mound to Pinellas. Pacific Northwest Laboratory (1979) covers fiscal year (FY) 1978 activities, Battelle Pacific Northwest Laboratory (1978) covers FY 1977 activities, and Battelle Pacific Northwest Laboratory (1977) covers FY 1976 activities. The three references are part of a yearly series reporting on the isotopes purchased by a list of customers, including Pinellas (referred to as GEND), from different DOE labs and the total isotope amounts shipped by those labs. Each report is organized into four sections, the first of which assigns a number to each customer. Pinellas is assigned No. 64 in Pacific Northwest Laboratory (1979), 91 in Battelle Pacific Northwest Laboratory (1978), and 81 in Battelle Pacific Northwest Laboratory (1977).

Table I of Pacific Northwest Laboratory (1979) shows that Pinellas purchased Pu-238 (amount not given) from Mound in FY 1978, and table IV shows that Mound sold 14.5838 kg and made 20 shipments of Pu-238 in total to all customers that fiscal year. In addition to Pinellas, 12 other sites ordered Pu-238 from all suppliers during FY 1978, with shipments of 28.0 nanocurie from Hanford, 14.5838 kg from Mound, 160.799 g from Oak Ridge National Laboratory (ORNL), (amount not listed) from Paducah, and 9.76 kg from Savannah River Plant for a total of 35 Pu-238 shipments.

Battelle Pacific Northwest Laboratory (1978), table I, shows that Pinellas purchased Pu-238 (amount not given) and H-3 (tritium) from Mound in FY 1977. Table IV shows that Mound sold 76.91 kg and made 39 shipments of Pu-238 in total to all its customers that fiscal year. In addition to Pinellas, 18 other sites ordered Pu-238 from all suppliers during FY 1977, with shipments of 76.91 kg from Mound, 1.012 kg from ORNL, 0.3572 from Battelle Pacific Northwest Laboratories, and 13.982 kg from Savannah River Plant for a total of 62 shipments to 19 sites of 92.262 kg Pu-238.

In summary, during FY 1977 and FY 1978, Mound sold a total of 91.4938 kg of Pu-238 in 59 shipments—the same total stated in APR (2026a). Although Pinellas purchased Pu-238 from Mound in those years, the quantities it ordered are not provided. The APR incorrectly assumes that all of Mound's Pu-238 sales were made exclusively to Pinellas, disregarding other customers.

Table I in Battelle Pacific Northwest Laboratory (1978) and table I in Pacific Northwest Laboratory (1979) show that many customers in addition to Pinellas also purchased Pu-238 from Mound in fiscal years 1977 and 1978. Neither report shows the amount purchased by any single customer. Furthermore, the referenced reports indicate only that Pinellas *purchased* Pu-238, not that it *received* any shipments. Purchase orders can be delayed or cancelled; therefore, a purchase does not necessarily equate to a completed shipment. Consequently, the APR's assertion that "two unaccounted shipments of Pu-238, totaling 91.4938 kg, were shipped from Mound to Pinellas Plant" is unsupported by the available evidence.

Furthermore, Pinellas received and shipped relatively large amounts of plutonium contained in sealed RTG heat sources, each with approximately 8 g of Pu-238, over its years of operation. For example, during a 5-month period in 1985, Pinellas shipped 111 RTGs containing a total of approximately 888 g of Pu-238 (GE, 1985); during a 9-month period in 1987, Pinellas shipped 173 RTGs containing a total of approximately 1,384 g of Pu-238 (GE, 1988); and in 1988, Pinellas shipped 217 RTGs containing a total of approximately 1,736 g of Pu-238 (GE, 1988). Thus, it was not unusual for Pinellas to receive and ship Pu-238 in kilogram quantities.[2] The amount of Pu-238 (in grams) at Pinellas is listed by year for the period 1975–1991 in "Radioactive Materials at Pinellas Plant 1956 – 1991" (ORAUT, 2013, PDF pp. 5 and 6). The amounts varied but were generally around 2,000 to 3,000 g of Pu-238. At 8 g of Pu-238 per RTG, this would equate to around 300 RTGs per year, and for a 10-year period would be a total of around 3,000 RTGs.

2.1.3.1.2 Worker interview: Loose plutonium and Cassini RTGs

APR (2026a) continues its section on Pu-238 with an excerpt from an undocumented interview with a former Pinellas worker:

> A former worker contends that Mound shipped Pu-238O_2 [plutonium dioxide] in powder form in sealed containers but opened by Pinellas Plant staff and converted to ceramic form. This was his comment obtained during interview: "Some Pu-238 was shipped to Pinellas in powder form and the material was processed into a ceramic form for use in NASA's [National Aeronautics and Space Administration's] radioisotope power system. They did like the Cassini Space Project and all these things. So, the secure transport would back up a truck and they would unload those 5 gallon buckets of Pu-238. I put them into a press." . . . [APR, 2026a, PDF p. 4]

APR (2026a) does not provide any documentation of this interview or information on the worker who was interviewed (APR, 2026d), preventing SC&A from assessing the accuracy of the quotation. A June 2026 APR letter revealed some interview information from one individual; however, it is not clear this was the same individual quoted and the information provided was an APR-produced summary.

SC&A searched for any information supporting the worker's statement regarding loose plutonium but did not find any. One document stated that plutonium *inside* the encapsulation was in shard, not powder, form (GE, 1991). Documents reviewed by SC&A—for example, U.S. Energy Research and Development Administration (ERDA) (1975a)—indicate that plutonium was under tight security, in encapsulated form (i.e., not loose), and received and shipped in

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[2] Most of the Pinellas RTGs were shipped to Mound and some to LANL. Most of the RTG models were MC2730A or MC3500.

approved shipping containers. Plutonium handled by workers was encapsulated; manipulated with tongs; and put inside work enclosures, such as a hood, or assembled into an RTG unit in a glovebox (GE, 1975, 1988). SC&A did not locate anything that would indicate there was loose or uncontained plutonium anywhere, or the need for health physics monitoring that would not normally be performed by an organization handling RTGs and neutron generators.

It is well known that GE (later part of Martin Marietta, subsequently part of Lockheed Martin) contributed to the U.S. space program at its Space Technology Center in King of Prussia, Pennsylvania. Responding to APR's (2026a) assertion of a NASA connection, SC&A investigated many sources to determine if Pinellas produced RTGs for the Cassini space project or any other NASA project. Several sources state what types of RTGs were used in space missions. The following is a selection:

- Grandidier, Woerner, and Burk (2018) report on the performance of the Cassini power supply. The paper says that the spacecraft was powered by three RTGs in parallel containing plutonium dioxide heat sources, generating 882.1 watts at the beginning of the mission. SC&A observes that this power level is considerably greater than the ones reported produced by Pinellas with thermal outputs of 4.0 and 4.5 watts and electrical outputs in the milliwatt range (LANL, 1994a, p. 3). A DOE article on the Cassini power source states that the three RTGs contained iridium-clad pellets of Pu-238 and that the plutonium was from the SRS and the iridium cladding from ORNL and the Y-12 National Security Complex, also in Oak Ridge, TN (DOE, 2017).

- A Lockheed Martin press release concerning the NASA Pluto New Horizons Probe, launched January 19, 2006, provides a clue about where the Cassini RTGs were produced (i.e., not at Pinellas): "A Radioisotope Thermoelectric Generator (RTG), built by Lockheed Martin . . . at its Space Systems Company facility in Valley Forge [Pennsylvania], then fueled by the U.S. Department of Energy (DOE), is providing electric power for NASA's Pluto New Horizons spacecraft" (Lockheed Martin, 2006).

- The Cassini RTGs were similar to the RTGs used on other space missions. This responds to the former worker's quotation which appears to generalize Pinellas's involvement in the space program beyond the Cassini mission. No information is available substantiating that Pinellas was involved in any of these other space missions. The New Horizons RTGs, for example, evolved from the Cassini RTGs as stated in an American Nuclear Society (ANS) news report from February 20, 2013: "The RTGs on the *Cassini* mission have the same design as those used on the New Horizons, Galileo, and Ulysses space probes . . . . One of the spare RTGs for the Cassini mission was used to power the New Horizons mission to Pluto and the Kuiper belt [beyond the orbit of Neptune]" (ANS, 2013).

- Lockheed Martin (2004) directly indicates where the Cassini RTGs were built: "In addition to the propulsion system, Lockheed Martin Space Systems Company designed and built the three radioisotope thermoelectric generators (RTGs) that power spacecraft systems and the Descent Imager/Spectral Radiometer (DISR) instrument on the Huygens probe" (Lockheed Martin, 2004).

- Johnson and Cockfield (2005) state the following:

> The Space Power Programs organization in King of Prussia, Pennsylvania, an offsite of Lockheed Martin Space Systems Company, provided the three General Purpose Heat Source – Radioisotope Thermoelectric Generators (GPHS-RTGs) used to provide electric power to the spacecraft during its mission to Saturn and its moons. The RTGs were the same design as those used to power the Galileo spacecraft on its mission to Jupiter and its moons, and the ESA [European Space Agency] Ulysses spacecraft on its mission to explore the Sun. Three RTGs provided 880 Watts of electrical power to the spacecraft at the beginning of mission. [Johnson & Cockfield, 2005]

- A 1997 Lockheed Martin Missiles & Space, Space Power Programs technical progress report on the Cassini RTG program states, "Activity under this subtask during the report period primarily dealt with shipment related activities supporting the delivery of the RTGs from Mound to the Kennedy Space Center" (Lockheed Martin, 1997a, p. 2-1).

- Lockheed Martin issued a final technical report, "GPHS-RTGs in Support of the Cassini Mission," in which it describes its activities in the program from January 11, 1991, through April 30, 1998. The report lists the several corporate entities involved in developing the Cassini RTGs:

> The Cassini GPHS-RTG program was initiated by the General Electric Company (GE) in 1991 under the Department of Energy (DOE) contract DE-AC03-91SF18852, entitled "General Purpose Heat Source Radioisotope Thermoelectric Generator (GPHS-RTG) for the CRAF [Comet Rendezvous-Asteroid Flyby]/Cassini RTG Program." As a result of business transactions during the period of this contract, in 1993 GE Aerospace became Martin Marietta Aeorospace, and in 1995 Martin Marietta became part of Lockheed Martin. GE/Martin Marietta documents and equipment were transferred to Lockheed Martin. The program was sponsored by the DOE Office of Special Applications and administered by the Oakland Operations Office. [Lockheed Martin, 1998, pp. 1-1–1-2]

In summary, SC&A reviewed a wide range of documentation, both the sources cited in this report and others, and found no evidence that Pinellas supplied RTGs to NASA, including for the Cassini mission. Given the scale and visibility of the Cassini program, it would be unusual for Pinellas to have participated without any reference to such work appearing in site records, historical documentation, or self-congratulatory press releases. The timelines also do not align: Cassini RTG development began in 1991 after RTG production at Pinellas had already ended, and the Cassini RTGs were substantially larger and more powerful than the units produced at Pinellas. Considering the available information, the interviewee's recollection appears to reflect a misunderstanding rather than work that actually occurred at the site.

2.1.3.2 Plutonium-239

2.1.3.2.1 Shipments

APR (2026a) states the following:

> In 1976 Mound shipped Pu-239, totaling almost 1 kg, to the Pinellas Plant though Pinellas Plant has no records of this shipment nor does it identify any project or work for which it was used. What was this plutonium used for? Were there other shipments for which we have not yet found records? The activity of the Pu-239 (about 20 Ci [curie]) is more than is typically used for a Pu-Be [plutonium-beryllium] source. Further, there is no documentation of a Pu-Be source being used at Pinellas Plant. There is no information on safety protocols used to dispose of the Pu-Be heat source in a safe manner. [APR, 2026a, PDF p. 4]

This statement miscalculates the activity of 1 kg of Pu-239. The generally accepted specific activity of Pu-239 is about 0.062 Ci/g, which is equivalent to an activity of 62 curies per kilogram (Ci/kg) (IT/RSL, 1986, p. 14; Lawrence Livermore National Laboratory (LLNL), 2011, table 1; LANL, 1994b, table 1), not 20 Ci/kg.

In the same section, APR (2026a) inserts two pictures from, presumably, Battelle Pacific Northwest Laboratory (1977) showing that the GEND Department (Pinellas) received Pu-239 from Mound in 1976 (amount unspecified) and that Mound shipped out a total of 983 g (approximately 61 Ci) of Pu-239, that year in total to all its customers. Pinellas was one of many customers.

Battelle Pacific Northwest Laboratory (1977), as discussed in section 2.1.3.1.1 of this report, covers FY 1976 radioisotope shipment activities from different suppliers to a variety of customers. Table I shows that Pinellas purchased Pu-239 (no Pu-238) and H-3 from Mound and krypton (Kr)-85 from ORNL that fiscal year. Table IV shows that Mound sold a total of 983 g of Pu-239 and made five shipments of Pu-239 in total to its customers in that fiscal year. Sixteen sites in addition to Pinellas ordered Pu-239 during FY 1976, with shipments of about 3.23×10^{-7} g (converting from 20 nanocuries at 0.062 Ci/g) from Hanford, 0.983 kg from Mound, and 0.1090 kg from ORNL for a total of 21 shipments to 17 sites of 1.092 kg Pu-239. It is inaccurate to assume Mound shipped all of its 0.983 kg of Pu-239 to Pinellas because Mound also shipped Pu-239 to many other sites in FY 1976. Further, the assertion about a Pu-Be source is not relevant in this discussion, since Mound likely shipped only a fraction of its Pu-239 for that year to Pinellas.

Because Pu-239 is not used by itself in RTGs and no Pu-238 was shipped to Pinellas in FY 1976, any Pu-239 received by Pinellas not contained in an RTG heat source was most likely for other purposes. For example, Pu-239 is commonly used as a calibration source in alpha-particle spectroscopy, which was used as part of the monitoring system at Pinellas,[3] since it emits several energetic alphas at around 5.1 MeV with a total intensity of almost 100 percent.

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[3] Section 2.1.3.3.1 of this paper refers to GE (1977, p. 3-15), which describes the plutonium measurement procedure used at Pinellas, including that it incorporated alpha spectroscopy.

It is also standard practice for facilities handling radioactive materials to maintain a broad inventory of check and calibration sources, including those containing Pu-239, all of which are managed under established health physics controls.

In addition, it is highly unlikely that a non-nuclear weapons production facility would receive on the order of 1 kg of unencapsulated Pu-239. The U.S. Nuclear Regulatory Commission (NRC) designates such quantities as Category II Special Nuclear Material (greater than 500 g but less than 2 kg) (NRC, 2020), which are subject to stringent safeguards. Only about 5 kg of Pu-239 are required to achieve criticality in an appropriate configuration with a neutron reflector, further limiting the availability of such material to non-weapons facilities. Notably, the production of new Pu-Be neutron sources in the United States, typically around 7.4×10^{10} becquerels (2 Ci), ceased in the 1980s due to nuclear safeguard concerns (Chabot, 2009).

2.1.3.2.2 Bioassays

APR (2026a)'s section on Pu-239 continues as follows:

> Interestingly in that same year of the unexplained shipment of Pu-239, 1976, an individual who worked with RTG in Building 400 was found to have a Pu-239 uptake about 9 times higher than the minimum detectable level (MDL). There is no recorded exposure to Pu-238. That individual only worked at Pinellas Plant according to plant records so the bioassay result could not have resulted from previous employment. . . . [4] According to NIOSH: "The data discussed herein, does not include the Pu bioassay taken in 1975. This bioassay predates the RTG program and were collected during a period when there were no Pu source term present at Pinellas."[5] [APR, 2026a, PDF pp. 4–5]

The APR alleges that in 1976 "an individual who worked with RTG in Building 400 was found to have a Pu-239 uptake about 9 times higher than the MDL." NIOSH located what appears to be the referenced bioassay (Pinellas Plant, 1957–1973, PDF p. 475, and Pinellas Plant 1975–1988, PDF p. 21). Notably the record that appears in the employee's files shows it is preoperational, lists a zero for Pu-238, and did not report Pu-239 (Pinellas Plant 1957–1973, PDF p. 475). A different summary form of bioassays for 1977, completed in November 1977, lists this bioassay and includes the cited Pu-239 result (Pinellas Plant 1975–1988, PDF p. 21). It is unclear why the records do not show the same result; however, the original record should receive greater evidentiary weight than the later summary record.

RTGs at Pinellas involved a mixture of Pu-238 and Pu-239. Any genuine contamination or intake from RTG work would produce a ratio of Pu-238 to Pu-239 consistent with that material, meaning Pu-238 would dominate heavily. A result showing Pu-239 with zero Pu-238 is therefore essentially impossible from RTG exposure, not merely unlikely. SC&A suspects that the sample may have been a mislabeled or mistranscribed spiked quality control sample because it does not

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[4] The APR cites "Department of Labor: Claimant Employment Occupational History." When queried on which claim this referred to, the APR did not provide the information.

[5] The petitioner cites the discussion on "Pinellas Plutonium Bioassay Data; Response to the follow-up of Issue 3 from the June 11, 2008 Working Group Meeting [ABRWH, 2008, pp. 41–93]."

fit the radiological profile of an RTG and no evidence exists that health physics staff evaluated it further.

The WG discussed the adequacy of the Pinellas plutonium bioassay program during June 11, 2008, and June 11, 2009, meetings as part of item 3. Those discussions concluded that the plutonium monitoring program was not robust by modern standards and did not conform to current rules and regulations. Workers were given baseline samples that were not consistently followed up. Few individuals were listed as being required to submit annual samples. Because no loose plutonium contamination was ever detected at the site, beyond low-level surface contamination identified during receipt inspections of RTG sources that was remediated within fume hoods prior to release into the facility, the bioassay program was not maintained as a priority. The results from this program are considered more representative of baseline monitoring than true occupational bioassay, and the data quality is insufficient to support definitive dose reconstruction conclusions.

Given the inadequacies of the plutonium bioassay monitoring program and the absence of loose plutonium contamination at the site, NIOSH previously agreed, with WG support, to address plutonium dose on a case-by-case basis. If a specific claimant has documented plutonium contamination in their record, a dose calculation will be performed for that individual using the best available minimum detectable activity data—either Pinellas-specific data if sufficiently reliable, or data from a comparable program if not. Any such dose is characterized as episodic rather than chronic in nature. As of January 2016, NIOSH had not received any claims involving plutonium bioassay results; however, given the time elapsed since that date, the current status of claims should be confirmed with NIOSH before relying on this figure. Despite extensive effort, no new information has been identified since that agreement that makes SC&A question that previous assessment.

APR (2026a) devotes nearly a page to criticizing the "First Plutonium" reference, which states that "the first receipt of plutonium at the Pinellas Plant was on January 18, 1957, when a 7-gram Pu-239 source was received to calibrate Health Physics monitoring equipment" (APR, 2026a, PDF p. 5). The APR correctly observes that the single copied page lacks an author, date, or any other identifying information. The document is part of a larger document by Martin Marietta (1993, PDF p. 158) prepared for DOE answering a series of questions; thus, the authenticity isn't in question. However, the critique also contains a significant factual error: the APR misidentifies the Pu-Be neutron source as a heat source. More importantly, the broader criticism misses the point: The source in question is a sealed source, meaning it presents an external exposure risk rather than an internal one. As such, it has no bearing on NIOSH's ability to bound internal doses at the Pinellas Plant.

The last bullet of the APR paper's section on Pu-239 states, "According to DOE Scientific and Technical Information (OSTI) the Temporary Plant was originally operated for the Department of Energy (DOE) by a division of GE Aerospace and GE Neutron Devices (GEND). This would account for RTG work being conducted at this facility prior to 1975" (APR, 2026a, PDF p. 5). SC&A does not see the relevance of this APR statement for two reasons:

1. The temporary plant is not a covered facility under the Energy Employees Occupational Illness Compensation Program Act and thus is beyond the scope of all SEC evaluation.

2. The APR statement does not demonstrate that RTGs were ever produced at the temporary plant. The history of the temporary plant in the Pinellas site description TBD (ORAUT, 2011b, pp. 11–12) does not mention production of any RTGs (which do contain plutonium). Instead, the plant began producing neutron generators (Model MC757), which do not contain plutonium, on September 4, 1956. Operations were terminated on May 19, 1957. The TBD states that the Pinellas Plant produced RTGs from November 1975 to 1990.

2.1.3.3 Pu-239 in the environment

APR (2026a) presents several claims that the appearance of Pu-239 in environmental measurements indicates that Pinellas was releasing Pu-239. This would then indicate the possibility of in-plant radiation sources exposing workers that NIOSH did not adequately account for.

2.1.3.3.1 Environmental measurements

APR (2026a) discusses potential environmental concerns, taking any positive offsite soil and water measurements of plutonium as evidence of releases from the plant:

> In 1976, Pinellas Plant staff reported positive results of Pu-239 in soil for both on-site and off-site sampling. NIOSH has provided no documentation or data to back up the assertion positive results are attributable to global fallout.
>
> Further, in 1977 Pinellas Plant staff found positive Pu-239 at twice the MDL in water samples. While there was likely still some airborne plutonium remaining from above ground testing, a concentration of 2.9 microcuries per milliliter (µCi/ml) is a high level of radioactivity in water that is highly unlikely to be caused by typical environmental fallout. The maximum concentrations observed in water from extensive fallout events are many orders of magnitude lower. [APR, 2026a, PDF pp. 5–6]

APR (2026a) apparently (no citation is given) copies table 5-2, "Summary of soil monitoring for plutonium" and table 5-4, "Summary of water monitoring for plutonium" from DOE (1994a). SC&A notes the following:

- APR (2026a) misreads the 1977 Pu-239 monitored concentration in water as 2.9 µCi/ml when, according to table 5-4 of DOE (1994a), the correct value is **2.9×10^{-11} µCi/ml**. The above quotation thus overstates the concentration by a factor of 10^{11}.

- With Pu-238 and Pu-239 having half-lives of 87.7 and 24,109 years respectively (NNDC, 2026), radioactive decay, particularly for Pu-239, is not a major factor in the time period after atmospheric testing ceased following signing of the Limited Test Ban Treaty by the United States and other nations on August 5, 1963.

- The MDL indicates the detection system sensitivity at a given time, and exceeding it does not imply that the concentration exceeds guidance or regulatory limits as APR (2026a) implies. In fact, an actual concentration might be below the MDL of one detection system and above the MDL of another, more sensitive system.

Environmental samples for Pu-238 and Pu-239 were taken in 1975 to establish preoperational levels in the areas around the Pinellas Plant (ERDA, 1975b). Table 5 shows relevant concentration ranges from this study.

Table 5. Preoperational ranges of plutonium concentrations in the environment

Medium	Pu-238	Pu-239
Soil	<0.8 to 3.1×10^{-9} microcuries per gram (µCi/g)	1.5 to 17.6×10^{-9} µCi/g
Water	<4 to 6×10^{-12} µCi/ml	<4 to 11×10^{-12} µCi/ml
Air	2.1 to 7.1×10^{-18} µCi/ml	23 to 89×10^{-18} µCi/ml

Source: ERDA, 1975b

The Department of Health and Rehabilitative Services State of Florida prepared DOE (1994a) using independent experts, under a grant from DOE. The study's introductory section states its purpose:

> In September 1990, the Department of Health and Rehabilitative Services (HRS) entered into an agreement with DOE to independently examine environmental monitoring data from the plant and health data from Pinellas County to determine if an epidemiological study is technically feasible to measure possible off-site health effects from ionizing radiation. [DOE, 1994a, p. 1]

Before directly addressing the two tables (soil and water monitoring), SC&A notes that Pinellas routinely monitored the environment for plutonium to confirm that no releases occurred. It is expected that any plutonium detected in environmental sampling, soil, and elsewhere and attributed to Pinellas would have first been detected by the airborne effluent monitoring system. Thus, absence of plutonium in the air measurements would imply absence of plutonium in the soil. Nonetheless, Pinellas monitored for the presence of environmental plutonium as stated in the following:

> Beginning in 1972, a formal, annual environmental report which summarizes the environmental activities of the plant was issued each year [1-21] [*sic*]. During the mid-1970's, six on-site and five off-site permanent air monitoring stations were installed (Figures 5-1 and 5-2). With the installation of these facilities, environmental monitoring has been done on a more regular basis. Starting in 1975, plutonium as well as tritium have been monitored but with new technology only recently. Currently, the monitoring program consists of testing water, air and soil both on and off-site. [DOE, 1994a, pp. 33–36]

The DOE report discusses air, water, and soil samples but focuses on the latter, noting the number and location of sampling stations:

> The soil samples have been monitored annually for plutonium since 1975 when the plant started to use plutonium for the manufacture of RTGs. Before 1987, the samples were taken on-site and off-site at a distance of five miles from the plant. In 1987, 14 on-site and 16 off-site sample locations were identified (Figure 5-3 and 5-4). Two on-site samples and four off-site samples were tested each year based on a soil sample location schedule (Table 5-1). Table 5-2 displays the

> summary of the monitoring results of soil samples [from 1976–1992]. [DOE, 1994a, p. 36]

The DOE report summarizes its findings about offsite Pu-238; its conclusion should apply to Pu-239 present in RTGs as well:

> Although plutonium-238 was used as part of a product [RTGs] between 1975 to 1990, there is no information suggesting that plutonium was released to the outside of the plant. Plutonium-238 is a radioactive material with half-life of 86.4 years. The available monitoring data for plutonium in air, water and soil indicate that the concentration of the plutonium in these samples was under the minimum detection limit on and off-site. [DOE, 1994a, p. 31]

DOE (1994a) Table 5-2, "Summary of soil monitoring for plutonium," presents Pu-238 and Pu-239 onsite and offsite activity measurements in microcuries per gram from 1976 through 1992. As quoted earlier, APR (2026a) states that, "In 1976, Pinellas Plant staff reported positive results of Pu-239 in soil for both on-site and off-site sampling" (PDF p. 5). While this is accurate—the table reports 4.0×10^{-9} μCi/g onsite and 6.8×10^{-9} μCi/g offsite in 1976—it does not establish evidence of a facility-related release. Some level of plutonium is expected in any soil sample, whether from trace natural sources (which are extremely small) or from widespread manmade sources unrelated to a specific nuclear facility. As noted earlier, these results simply indicate that the measured values exceeded the detection system's MDL, which reflects only the sensitivity of the instrumentation. They do not demonstrate levels above background, nor do they indicate any risk to human health.

Section 2.1.3.3.2 of this report discusses whether the detectable plutonium levels exceeded those that could be attributed to global fallout. Interestingly, the Pu-238 and Pu-239 soil concentrations fell below MDL in most following years.

APR (2026a) included a copy of DOE (1994a) Table 5-4, "Summary of water monitoring for plutonium," which presents Pu-238 and Pu-239 onsite and offsite activity measurements in 1976, 1977, and 1978. SC&A conducted a deeper review of these plutonium data by examining soil and water measurements presented in the annual Pinellas environmental monitoring reports that form the basis for the tables in DOE (1994a). Specifically, the 1976 soil data of DOE (1994a) appear in GE (1977) and the 1977 water data in GE (1978). GE (1977) table 3-8 shows the onsite range of Pu-239 in the soil for 1976 as $3.0–5.4\times10^{-9}$ μCi/g for the different sampling sites, with an average of $4.0\ (\pm1.1)\times10^{-9}$ μCi/g. MDLs are given as $0.5 – 4.3\times10^{-9}$ μCi/g for plutonium. GE (1977) table 3-10 shows the offsite range of Pu-239 in the soil for 1976 as $1.4–13.2\times10^{-9}$ μCi/g for the different sampling sites, with an average of $6.8\ (\pm3.2)\times10^{-9}$ μCi/g and an MDL of $0.4–4.4\times10^{-9}$ μCi/g. A note at the bottom of both tables says, "Results showing less than the minimum detection level were assigned this value when computing averages." The plutonium measurements were all carried out using the same procedure. (However, MDL values vary even when using the same procedure because of variables in the process, such as background counts, sample counts, chemical recovery, etc.)

GE (1978) contains the 1977 plutonium water monitoring data appearing in table 5.4 of DOE (1994a). Table 3-10 gives the offsite Pu-239 concentration range as $1.0–7.0\times10^{-11}$ μCi/ml with an average of 2.9 (±2.8)×10^{-11} µCi/ml and an MDL of 0.7–1.5×10^{-11} µCi/ml. A note at the bottom of the table says, "Results showing less than the minimum detection level were assigned this value when computing averages" (GE, 1978).

SC&A previously examined environmental soil measurements for plutonium appearing in all the yearly environmental monitoring reports, with particular attention to GE (1981) and GE (1982b) for the years 1980 and 1981 respectively, which APR (2023) cites. This report presents SC&A's observations for reference. Much of the text in the reports for the two different years is either the same or very similar; however, the values in the tables differ. Monitoring data appear in table 3-6, "Plutonium Stack Monitoring"; table 3-7, Perimeter/Plutonium Air Samples"; and table 3-9, "Plutonium Soil Samples." Table 3-8, "Off-Site/Plutonium Air Samples," shows the results of the samples analyzed from each of the offsite sampling stations. This report will focus on the soil sample data appearing in table 3-9 of GE (1981) and GE (1982b).

The data in these tables strongly indicate that the plant did not add "additional" plutonium to the environment. MDL values changed from 0.3–1.2×10^{-9} µCi/g for Pu-238 and 0.2–0.6×10^{-9} µCi/g for Pu-239 in 1980 to 1.4–6.6×10^{-9} µCi/g for Pu-238 and 1.8–5.4×10^{-9} µCi/g for Pu-239 in 1981. The discussion portion at the end of the plutonium section states, "The results of all the various types of samples described above are comparable to those found during the preoperational survey conducted prior to the introduction of the plutonium sources at this site. The results are also in agreement with environmental levels detected at other locations and attributed to global fallout" (GE, 1981 p. 3-16; GE, 1982b, p. 3-18). The "Evaluation of Potential Dose to the Public" sections of both environmental reports conclude, "There was no radiation dose to the public from the utilization of plutonium at the Pinellas Plant since none was released to the environment" (GE, 1981, p. 4-1; GE, 1982b, p. 4-1).

SC&A notes that although the Pinellas environmental monitoring reports state that "the results are also in agreement with environmental levels detected at other locations and attributed to global fallout," they don't provide any evidence that this is so. This paper discusses this issue in section 2.1.3.3.2.

2.1.3.3.2 Fallout

SC&A reviewed the literature on typical environmental plutonium levels, particularly from fallout, to help determine whether the presence of plutonium in the environment around Pinellas might indicate releases from the plant. Very small quantities of plutonium are always found in the environment primarily due to neutron capture by U-238 in uranium deposits, nuclear facility accidents, and nuclear weapons testing. As discussed in the Pinellas IT/RSL (1986) report, this comprises a non-zero "background" of plutonium varying by location, but unrelated to normal nuclear facility operations:

> Trace amounts of plutonium can be found wherever uranium exists in nature due to nuclear reactions by cosmic rays and their products with uranium-238. Since these naturally-occurring levels are quite low, isotopes of plutonium normally found in environmental samples are primarily a consequence of nuclear weapons production and testing. [IT/RSL, 1986, p. 14]

Nuclear forensics, relying on isotopic analyses using alpha spectrometry to give plutonium isotopic ratios (Harley, 1980, p. 83), can determine not only the type of plutonium source, but, often, its specific origin (e.g., which nuclear power plant or weapons test is responsible for it). SC&A reviewed reports on measured plutonium isotopic concentrations, often given in the form of isotopic ratios, away from potential sources such as nuclear facilities. Table 1 of this report shows that about 300 kiloelectron volts (keV) separate the Pu-238 and Pu-239 primary alpha particle emission energy peaks, which spectroscopy can easily distinguish (Harabagiu et al., 2021, p. 2).

Many worldwide studies since nuclear testing began in 1945 have measured plutonium isotopic ratios of fallout. Unfortunately, for our purposes, due to technical reasons, they primarily determined the characteristic ratio of Pu-240 to Pu-239, which is typically taken as about 0.176 ± 0.02 (e.g., Tighe et al., 2021; Krey et al., 1976; Wu, 2019; Buesseler, 1997; LLNL, 1984). However, SC&A located one study by the U.S. Atomic Energy Commission Health and Safety Laboratory (HASL) (1972) that gives the desired Pu-238 to Pu-239 fallout ratio as about 0.036, which is very different from the ratio of about 5 expected from Pinellas RTG material.

2.1.3.3.3 Plutonium isotopic ratio comparisons

To assess whether the plant might have emitted plutonium, this section compares the data discussed in the previous three sections on the plutonium isotopic compositions of the Pinellas RTG heat sources, the Pinellas environmental measurements, and global fallout from nuclear weapons tests. “First Plutonium” (n.d.) states:

> Fall-out plutonium has been detected at the Pinellas Plant, but analysis for releases of RTG plutonium focuses on the isotopic ratio of 80% weight Pu-238 and 16% by weight Pu-239. Pu-238 and Pu-239 have not been found in these ratios in environmental samples; therefore, no releases from Pinellas Plant operations have been detected in the environment. [“First Plutonium,” n.d., PDF p. 2]

As discussed in section 2.1.3.3.2 of this report, the average weight ratio of Pu-238 to Pu-239 deposited in soil from fallout is approximately 0.036 compared to the expected Pinellas plutonium ratio of about 4–5. SC&A finds that this is strong evidence that the measured activity does not represent a plutonium release from the RTGs in the plant, but rather that it is from non-plant sources such as fallout.

DOE (1994a) table 5-2 is a summary of onsite and offsite soil monitoring results for Pu-238 and Pu-239 at Pinellas from 1976 through 1992. Almost all the results are listed as below minimum detection levels (which indicate below MDL levels) or less than some value, which are not useful in computing a mass (m) ratio of the isotopes. For example, the 1976 offsite results show specific activities per gram of soil of less than 1.9×10^{-9} μCi/g for Pu-238 and 6.8×10^{-9} μCi/g for Pu-239. To obtain weight ratios of the two plutonium isotopes, the activities must first be converted to equivalent masses by dividing the activities by 1.714×10^{7} μCi/g for pure Pu-238 and 6.2×10^{4} μCi/g for pure Pu-239:

$$m(\text{Pu-238})/m(\text{soil}) = (<1.9\times10^{-9}) / (1.714\times10^{7}) = <1.109\times10^{-16} \text{ g Pu-238/g soil}$$

$m(\text{Pu-239})/m(\text{soil}) = (6.8\times10^{-9}) / (6.2\times10^{4}) = 1.097\times10^{-13}$ g Pu-239/g soil

$m(\text{Pu-238})/m(\text{Pu-239}) = <0.00101$ ($<0.101\%$)

The 1980 results are the only ones listed in table 5-2 that have actual numbers for offsite activities for the two plutonium isotopes: 3.8×10^{-9} µCi/g for Pu-238 and 9.6×10^{-9} µCi/g for Pu-239**:**

$m(\text{Pu-238})/m(\text{soil}) = (3.8\times10^{-9}) / (1.714\times10^{7}) = 2.217\times10^{-16}$ g Pu-238/g soil

$m(\text{Pu-239})/m(\text{soil}) = (9.6\times10^{-9}) / (6.2\times10^{4}) = 1.548\times10^{-13}$ g Pu-239/g soil

$m(\text{Pu-238})/m(\text{Pu-239}) = 0.001432$ (0.143%)

The 1976 and 1980 results are in good agreement given that the 1976 Pu-238 activity result is shown as "less than." The next step is to compare the measured soil mass ratios to the ratio characteristic of the RTG sources, which is about 80 percent Pu-238 to 16 percent Pu-239 by mass for a mass ratio of about 5 (80 divided by 16). This is much different than the 1976 ratio of less than 0.00101 and the 1980 ratio of 0.001432.

SC&A concludes that the investigations in sections 2.1.3.3.1–2.1.3.3.3 provide strong support for the assertion that the offsite plutonium samples are not attributable to the Pinellas Plant, contrary to the assertions in APR (2026a).

2.1.3.3.4 DOE health and mortality studies

APR (2026a) states the following:

> ORISE [Oak Ridge Institute for Science and Education] in its *DOE Health and Mortality Studies, >5 REM Study* listed Pinellas Plant as a concern for plutonium. That work is a retrospective cohort mortality and morbidity study of all workers throughout the United States who received at least 5 rem [roentgen equivalent man, a unit of radiation dose] of penetrating ionizing radiation during one calendar year before 1979 while employed at DOE nuclear facilities or the U.S. Navy's Nuclear Reactor Propulsion Plants. The registry of 5 rem workers was assembled between 1979 and 1982 in response to Congressional concern about the long-term health effects on DOE and predecessor agency workers of exceeding the 5 rem occupational radiation standard for external radiation. [APR, 2026a, PDF p. 6]

The referenced ORISE report was part of an extensive effort to collect data with the goal of determining the correlation, if any, between radiation exposures at DOE and contractor sites to the incidence of different cancers.

Voelz et al. (1982) state the following:

> Currently this [ORISE health and mortality] research focuses on evaluating the effects of plutonium exposure in man. The major programs consist of 1) epidemiologic studies of the incidence of disease and mortality among plutonium

and other workers at six Department of Energy (DoE) contractor facilities (Los Alamos, Rocky Flats, Mound, Savannah River, Hanford, and Oak Ridge), and 2) measurement of plutonium and other radionuclides in human tissues. [Voelz et al., 1982, PDF p. 2]

Pinellas was included in the early planning list for the study, but it was not part of the final group. This is likely because workers at Pinellas did not receive annual doses above 5 rem, which was the focus of the study. Whether Pinellas was included or not has no impact on the ability to reconstruct doses for the site.

2.1.4 Conclusions about plutonium at Pinellas

Based on the evidence from reexamining all the SC&A and NIOSH reports as well as site records and the scientific literature, SC&A has not found convincing evidence that personnel were exposed to unencapsulated plutonium, which reinforces the WG's decision to discount that possibility:

- No plutonium contamination was found within the plant, including on the outside of the plutonium heat sources themselves and on completed RTGs.
- No plutonium was detected from airborne measurements.
- No plutonium was detected from stack monitors.
- Environmental samples did not contain plutonium results corresponding to the characteristic RTG Pu-238 to Pu-239 isotopic weight ratio.

2.2 Uranium and Heather Project

APR (2026a) contains a section, "Uranium/HEATHER Project" (APR, 2026a, PDF pp. 7–10). This section begins with a description of the Heather system as developed as part of a tritium gas filling system located in Pinellas Building 300 (attached to Building 100). The description cites a "SRS Gas Transfer System Factsheet" (DOE, n.d.). APR (2026a), PDF page 8, claims that Heather activities took place in Building 300 as follows:

- Heather Glassing Shop: Building 100, Area 327
- Heather Glassing Shop: Building 100, Area 330
- Heather Electron Beam Welding Shop: Building 100, Area 331
- Heather Testing Shop: Building 100, Area 336

SC&A observes that the referenced fact sheet (DOE, n.d.), which pertains to the SRS, does not mention Pinellas. The Pinellas site description TBD does not mention the Heather project and contains only a short description of Building 300: "Building 300 primarily performed nonradiological activities. However, radioactive materials were handled in a number of areas within Building 300. Tritium was handled in Area 348 and glass doped with natural uranium was handled in Areas 327, 330, 331, and 336" (ORAUT, 2011b, p. 31). The TBD does not give the titles of the areas. However. SC&A did find the four shop titles listed above, which include "Heather," for those four Areas in the U.S. Department of Labor (DOL) Exposure Matrix for Pinellas (DOL, 2024).

The APR (2026a) Heather section states: "Over 3000 gas transfer systems were produced in Building 300 just for the W76 warheads alone (1971-1988)" (APR, 2026a, PDF p. 8) and cites LANL (2018) as the source of this information. SC&A notes that this technical paper, which briefly lists 10 LANL accomplishments in the nuclear weapons program, does not support the APR (2026a) claim because it only states the following as the ninth accomplishment, quoted here in its entirety: "Los Alamos developed gas transfer system technologies to improve overall weapon performance margins and increase component lifetimes. These solid-storage gas transfer systems deliver a boost gas mixture containing negligible helium-3 with nearly constant tritium and deuterium quantities over the lifetime of the system" (LANL, 2018, p. 2). It does not mention Heather, Pinellas, or the number of gas transfer systems produced.

SC&A searched for where the 3,000 number could have come from and located one reference that the APR sent to the Advisory Board on Radiation and Worker Health (ABRWH) in 2024 (APR, 2024), which consists of untitled, unreferenced, undated pages discussing updating the basic W76 Trident warhead. That paper's endnote number 1 states, "Over 3,000 warheads were produced. As well as the operational warheads a significant number of spare plutonium pits for W76 are stored at the Pantex nuclear weapons factory." (PDF p. 3). The paper does not mention Pinellas or the Heather project.

The Heather project section of APR (2026a) cites an interview with a Pinellas Plant Health Physicist to the effect that Pinellas workers produced Heather components from borosilicate glass doped with uranium oxide (U_3O_8) using "special hydrogen blow torches" prior to forming and cutting it into the desired glass tubing (APR, 2026a, PDF p. 8).

SC&A followed up by assessing Weaver (1992), which is a compendium of miscellaneous documents and notes related to U_3O_8. The first document, "Summary: Natural Uranium Glass Concerns," states the following:

> An existing operation at the Pinellas Plant uses glass containing (1.5% by weight) naturally occurring uranium oxide (U_3O_8). This operation has been conducted for many years. Processes with this glass have been reviewed to assess worker radiation exposures and potential environmental impact (Weaver, 1992, PDF p. 2).

This statement supports the assumption that the glass arrived at Pinellas *already doped with uranium* in the form of natural U_3O_8 as a sealed source. Another document in Weaver (1992), "Natural Uranium Glass Process Analysis," states the following:

> An existing operation at the Pinellas Plant processes glass containing (1.5% by weight) naturally occurring uranium oxide (U_3O_8). The glass is both cut and chemically etched as part of the operation.
>
> These two processes have been conducted for many years. The written specifications for the glass state the composition of the material, including the presence of the uranium oxide. . . . A review of the processes was initiated to assess worker radiation exposures and potential environmental impact.

> Personnel exposures during handling were assessed using conservative work periods and measured dose rates. Estimated worse case exposure to whole body and extremities are well below the US Department of Energy (DOE) annual limits (5000 mrem/yr [millirem per year] whole body (WB) and 50,000 mrem/yr extremities). [Weaver, 1992, PDF p. 27]

A handwritten document in Weaver (1992), "Proposed Action," and initialed by the author on January 21, 1992, lists operations to be assessed in support of the health physics program as storage and process. Under the process heading, the author lists preparation, cutting, etching, inspection, and assembly (Weaver, 1992, PDF p. 29). Doping glass with uranium is not mentioned.

APR (2026a)'s section on the Heather project continues with the following statement:

> Former employees assigned to Building 300 HEATHER/HELIX confirm they did not wear any monitoring devices or PPE [personal protective equipment]. Glass blowers clearly stated that they used uranium powder to dope borosilicate glass. They also were responsible for blowing helix.[9] The following photo provides evidence of employee doping uranium glass in Building 300 and clearly shows employee not wearing any protective equipment to prevent exposure to U_3O_8. [APR, 2026a, PDF p. 8]

SC&A observes that the photo referred to in APR (2026a, PDF p. 9) does not provide any information, such as a citation to where it was taken from, to connect it to glass tube operations, specifically, to doping tubes with uranium at Pinellas. Citation 9 in the above quotation refers to four audio files of interviews conducted on May 8–9, 2025, that SC&A does not have access to determine their relevance.

In further expressions of concern about the possible presence of loose (unencapsulated) U_3O_8, APR (2026a) states, "There is no available data regarding how U_3O_8 was stored. Was it stored as a powder? Why is U_3O_8 not identified as an isotope of concern in Building 100, Area 110 nor HEATHER facilities?" (APR, 2026a, PDF p. 9). SC&A did not find any related information that would support the assumption that there was loose U_3O_8 at Pinellas, which might be the reason that APR (2026a) also could not locate such information.

APR (2026a, PDF p. 9) continues as follows:

> [Redacted] provided the following about U_3O_8:
>
> - Stated that better monitoring must be implemented for U_3O_8.
> - Suggested the implementation of extremity dosimeters including the use of finger rings.
> - Stated U_3O_8 was stored in Building 100, Area 110 though there is no available documentation identifying U_3O_8 as being stored in Building 100.
> - [redacted] reported there were no shipping labels on incoming boxes of U_3O_8.

A footnote in the paper references "[Redacted]": "[redacted] (01/03/1992) Summary: Natural Uranium Glass Concerns" (APR, 2026a, PDF p. 9), which this report identifies as the first paper in the Weaver (1992) compilation. SC&A discusses Weaver (1992) earlier in this report and did not find any indication of loose uranium at Pinellas. That document compilation discusses monitoring for U_3O_8, including finger rings for inspectors and cutters, who would have handled the uranium-doped glass tubes, and better labeling on boxes that contain U_3O_8 as part of the health physics review for uranium monitoring. However, that could just as well apply to U_3O_8 already encapsulated in glass tubes received by Pinellas. SC&A could not locate any statement about where the U_3O_8 might have been stored.

APR (2026a)'s section on the Heather Project concludes with a summary of the APR's contention:

> There is clear evidence PP [Pinellas Plant] staff worked with uranium materials starting in 1966. On what evidentiary grounds does DCAS [Division of Compensation Analysis and Support] claim the glass was already doped with uranium dioxide (UO_2) when it arrived? Why has [*sic*] DCAS and ORAU [Oak Ridge Associated Universities] continue [*sic*] to deem uranium as an improbable uranium internal exposure pathway! Documentation of the amount of uranium used at Pinellas Plant has not been found or made available to the author of this report. Neither documentation on monitoring is available. There in [*sic*] insufficient data and documentation to perform dose reconstructions for uranium starting in 1966. [APR, 2026a, PDF pp. 9–10]

SC&A notes that APR (2026a) changed its compound of concern from U_3O_8 ("yellowcake") in previous quotations to UO_2 (uranium dioxide) in the above quotation. With regards to the latter, uranium dioxide is pyrophoric, especially as a fine powder. Pyrophoric materials are substances that ignite spontaneously upon exposure to air or moisture, without any external spark or flame. If it were used on site, specific procedures would be required for safety. SC&A has not identified any credible evidence that borosilicate glass was doped with uranium dioxide on site at Pinellas. However, SC&A reviewed a Corning Material Safety Data Sheet (MSDS) dated July 1986 (Pinellas Plant, 1969–1994, pp. 4–5). MSDS forms are standardized manufacturer-prepared documents that communicate occupational safety and health information. This MSDS indicates that the borosilicate glass contained uranium oxide (a general term encompassing UO_2 and U_3O_8), with the uranium oxide comprising less than 1 percent of the glass by weight.

A January 1969 design control document for hard-sealing glass (Pinellas Plant, 1969–1994, pp. 8–11) specifies that the glass was formulated with 1.5 percent uranium oxide by weight and required suppliers to certify compliance with that specification. Corning Glass Works was listed as the sole approved supplier. Although the two sources report slightly different concentrations, both confirm that uranium oxide represented only a small fraction of the glass composition and support the assertion that the glass doping occurred prior to the glass arriving at Pinellas.

Following the Tiger Team report, the site contracted an independent laboratory, Martin Marietta Specialty Components, Inc., to analyze the radiological composition of the glass (Pinellas Plant, 1969–1994, p. 6). The lab determined that the uranium oxide present was consistent with natural uranium (pp. 15–21).

Additionally, a handwritten record in the same file (Pinellas Plant, 1969–1994, pp. 29–30) notes that the highest-exposed workers handling the glass received an estimated whole-body dose of 15 mrem per year (and 75 mrem per year to extremities), levels that fall below DOE monitoring thresholds. Taken together, this information indicates that the uranium was already present in the glass when it arrived at the facility and that it contributed only a small potential exposure risk to workers.

SC&A located an additional design control document for preparation of glass ceramic that involved melting powders to form a glass (Pinellas Plant, 1975). This process did not involve uranium oxide but may be the powder-involving process being recalled by the individual interviewed by APR.

SC&A had investigated the Heather project in section 6.1 of its supplemental review report (SC&A, 2025) in response to several documents submitted by the APR as follows:

> SC&A reviewed all those APR materials and some additional materials it found in the open literature. Although parts of the Heather project were classified, all the materials examined were unclassified. It appears that the Heather project developed a glass component (sometimes referred to as a "helix" or "bent glass") as part of the tritium delivery system in a nuclear weapon. [SC&A, 2025, pp. 13–14]

In summary, SC&A did not find any evidence that Pinellas workers doped the borosilicate glass with uranium or that there was any loose U_3O_8 powder (which is pyrophoric and would require special handling) in the plant, contrary to the claim of APR (2026a).

2.3 Thorium

APR (2026a) section III discusses the possibility of thorium at Pinellas, relying on a *Wall Street Journal* (WSJ) article (WSJ, 2014) to claim that Pinellas processed thorium, potentially exposing personnel to radiation that was not accounted for or monitored. The article discusses the processing of thorium at the General Electric Company X-ray Division Pilot Plant in Milwaukee, Wisconsin, as well as developing neutron generators, "which included a small, protected capsule of the radioactive element Tritium. When this [neutron generator] project was scaled to full production in the mid-1960s, it was transferred from Milwaukee to a facility in Florida [Pinellas]. The project was closed down some years later" (WSJ, 2014, PDF p. 2). Hence, the article states that the neutron generator project and not the thorium processing activity was transferred to Pinellas. The article explains why Pinellas documentation does not refer to thorium processing and responds to the APR (2026a) statement that "There is no evidence of any type of monitoring of thorium and associated isotopes, nor is there available evidence regarding any incidents associated with thorium at Pinellas Plant. There is [*sic*] insufficient data and documentation to perform dose reconstructions for thorium starting in 1966" (APR, 2026a, PDF p. 10).

SC&A searched the SRDB for mentions of thorium at Pinellas and found the following:

- General Electric Company (n.d.): In response to a DOE questionnaire about radiation hazards, a Pinellas health physicist indicated under the Nuclear Fuel Cycle category thorium line that "thorium mining, milling, or processing" (PDF p. 7), were not applicable.

- GE Aerospace (1990) attaches a Pinellas radioisotope material inventory whose only reference to thorium is "Thorium-230, standards, $1{\times}10^{-8}$ curies activity" (PDF p. 4) which is a very small activity, equivalent to 370 becquerel (370 disintegrations per second (sec)).

- DOE (1999) consists of a table, "Nuclear Materials Maximum Allowable," prepared by the DOE Albuquerque Operations Office. Under General Electric Neutron Devices for Building 100 as of April 1, 1989, the table lists thorium-230, "standards/encapsulated," $1{\times}10^{-8}$ curies activity (PDF p. 28). This is in agreement with the data in GE Aerospace (1990).

- [Redacted] (2013) is a summary report of a documented telephone interview with a Pinellas health physicist on past radiological control practices at the Pinellas Plant with an emphasis on the controls for metal tritides. The interviewee stated the following:

  > The machine shop had some concern about grinding thorium welding rods. They would grind the tips to get a better weld. This was done as a dry operation, short term before they stopped that activity. Thorium was limited to the rods only. There was no exposure from the rods and there was no other thorium bearing materials at the plant. [[Redacted], 2013, PDF p. 8]

- Lockheed Martin Specialty Components, Environmental Safety and Health Division, produced a comprehensive report in 1997 for DOE in support of the effort to "achieve a safe transition of the facility from defense production and prepare the site for alternative uses as a community resource for economic development. Toward that effort, the Pinellas Plant Environmental Baseline Report (EBR) discusses the current and past environmental conditions of the plant site" (Lockheed Martin, 1997b, p. 1-1). All areas of the plant are characterized. The only mention of the presence of thorium is in Building 100, Areas 155A–D, the chemistry laboratory, which tabulated the chemicals that "may have been used or handled" and included thorium nitrate (Lockheed Martin, 1997b, p. 3-43, 3-44). The report later summarizes, "The list of radioisotopes is considered complete since careful records of the management of these substances are available from 1957 to the present" (Lockheed Martin, 1997b, p. 9-1).

SC&A found no evidence of thorium processing at Pinellas: The only presence of thorium was in a very small, contained amount in the nuclear instrumentation laboratories and in welding rods containing thorium, a common industrial practice. Neither application requires internal thorium monitoring.

2.4 Special tritium compounds

The special tritium compounds section of APR (2026a), PDF p. 10, begins with a quotation from the Pinellas internal dose TBD, ORAUT-TKBS-0029-5, revision 03, and agrees with it:

> Four types of tritium compounds were present at the Pinellas Plant: tritiated water (HTO . . .), tritium gas (HT . . .), organically bound tritium (OBT), and metal tritides (MTs). Based on the available records, the predominant tritium exposure hazard to the workers was from HTO and HT. However, in some circumstances workers might have also been exposed to OBT compounds and MTs. [ORAUT, 2016, p. 9]

The TBD continues, "The most common OBT compounds at the Pinellas Plant were contaminated pump oils and organic solvents (e.g., alcohol, toluene, acetone, etc.) that were used in the tritium areas" (ORAUT, 2016, p. 9). APR (2026a) states that the TBD lists scandium tritide, erbium tritide, titanium tritide, and depleted uranium tritide as the primary special tritium compounds (APR, 2026a, PDF p. 10).

After agreeing with the preceding facts concerning special tritium compounds contained in the internal dose TBD, APR (2026a) states its disagreement with the dose calculation procedure:

> This report does not agree with the assertion that NIOSH can bound doses to unspecified organically bound tritium compounds and to scandium tritide, erbium tritide and titanium tritide using the assumptions and equations given in ORAUT-TKBS-0029-5 Rev. 03 Section 5.1.8.2. Further, NIOSH totally dismissed any dose from uranium tritide as they assert uranium tritide was enclosed in glass. The report shows how that assertion is questionable. What about dose from OBT compounds? [APR, 2026a, PDF p. 11]

SC&A notes that APR (2026a) does not provide any details to support its assertion that NIOSH cannot bound doses from the named sources. The internal dose TBD (ORAUT, 2016) provides information and guidance about special tritium compounds. In addition, the ORAUT technical information bulletin (OTIB), ORAUT-OTIB-0066, "Calculation of Dose from Intakes of Special Tritium Compounds" (ORAUT, 2020), presents detailed information about how to determine doses from these sources. SC&A reviewed ORAUT (2020) in an April 28, 2021, memorandum (SC&A, 2021) and found that it adequately addresses the concerns arising from SC&A's prior review of revision 0 of that OTIB (ORAUT, 2007).

The internal dose TBD elucidates the use of uranium tritide at Pinellas:

> The stainless-steel tritium storage beds utilized a different MT [than the titanium tritide ones], depleted uranium (DU) tritide (Burkhart 1990; Eichman 1979; Phillips 1975). Because DU tritides were sealed within a stainless-steel construction, and because there are no known incidents of DU tritide contamination at the Pinellas Plant, exposures to DU and DU tritide were unlikely. [ORAUT, 2016, p. 9]

SC&A did not find any evidence that the uranium tritide was not bound, i.e., loose.

APR (2026a) references a Mound Laboratory document (Mound, 1959):

> There is also the question of whether all incidents involving special tritium compounds were identified and considered. As an example, this statement was

> given in the December 1959 Mound Health Physics Report (Mound apparently provided some health physics support for PP [Pinellas Plant] in 1959): . . .
>
> > During this quarter, the salt recovery operation required very close survey. The processing of the titanium tritide materials of the Pinellas Plant has led to several contamination spread incidents. This material is very difficult to contain in the hood system.
>
> [APR, 2026a, PDF p. 11]

APR (2026a) concludes, "That statement refutes NIOSH assertions that titanium tritide was easily controlled" (APR, 2026a, PDF p. 11). SC&A reviewed the cited document and found the APR's statements are not consistent with the documentation. There is no evidence supporting the APR's claim that Mound provided health physics support for Pinellas. The cited document represents a health physics report for Mound, not Pinellas Plant. The contamination referenced occurred *at Mound* using titanium tritium materials *from* Pinellas. Mound contamination incidents are not covered by a potential SEC for Pinellas.

The internal dose TBD states the following:

> Titanium tritide was also used in the original tritium storage beds at the Pinellas Plant (Burkhart 1990). In the original tritium storage beds, the titanium tritide was sealed inside a glass cylinder (Burkhart 1990). Because the glass cylinders for the tritium storage beds broke on occasion, resulting in high levels of contamination, the original glass tritium storage beds were replaced with stainless-steel tritium storage beds in 1968 (Phillips 1975). [ORAUT, 2016, p. 9]

This quotation appears to support the APR (2026a) assertion that the tritium tritide glass cylinders broke and caused contamination at least until the containment system was replaced by a better one in 1968. Table 5-1 of the internal dose TBD lists all the areas potentially containing tritium. However, none of the assertions in the APR (2026a) section on special tritium compounds refutes the ability of NIOSH to adequately reconstruct doses from tritium exposures from the large numbers of available bioassay and contamination data.

2.5 Americium-241

Section V of APR (2026a) concerns americium (Am)-241 and quotes the following from the Pinellas external dose TBD, ORAUT-TKBS-0029-6, revision 02:

> In approximately 1988, the Pinellas Plant acquired a 10 Ci ^{241}Am source for unknown reasons. The source was an encapsulated americium-beryllium (Am-Be) neutron source, which was likely used as a calibration source. By October 1991, the Am-Be neutron source was inactive and in the process of being excessed ([*Historical radionuclides and sources inventory*, n.d.]). [ORAUT, 2017, p. 11]

APR (2026a) then presents a series of issues, which this report will discuss in turn:

- "What is the basis of the authors' assumption that the 10 Ci Am-241 is associated with an encapsulated neutron source of americium and beryllium? If that was the case, then why would they first acknowledge that they did not know the purpose of the acquisition?" (APR, 2026a, PDF p. 11).

  DOE (1994a) appendix 3 (p. 111), "Pinellas Plant Radioactive Source Historical Inventory/Status," lists four Am-241 sources; the relevant part of that table is reproduced here as table 6.

  Table 6. Pinellas radioactive source historical inventory: americium

Initial activity/date [(a)]	Sealed/unsealed	Uses	Status	Date
0.11 µCi, 7/11/77	U	Alpha source	Active	10/91
500 µCi, 6/11/68	U	Alpha source	Active	10/91
10 Ci, 1988	S	Am-Be	Inactive/being excessed	10/91

  Source: The table is recreated from DOE (1994a), appendix 3.
  [(a)] Am-241's half-life is 432 years, so the initial activities decreased by only a small amount during the lifetime of the Pinellas Plant.

  The first two americium sources have relatively low activities and were used as alpha particle sources, probably for calibration purposes. The last entry has a much greater activity of 10 Ci and is listed as a *sealed* Am-Be source.

  Am-Be neutron sources are commonly used for various industrial applications such as calibration, industrial gauging, oil well logging, and active neutron interrogation for nuclear security applications. Alpha particles resulting from the radioactive decay of americium interact with beryllium and produce neutrons with average energy of 4.2 MeV. A review of the literature from some suppliers of Am-Be sources shows that a 10 Ci source is not unusually large and that all sources are encapsulated in stainless steel. For example, the QSA Global website states that "QSA Global, Inc. has over 60 years of experience developing and manufacturing Am-Be sealed sources for industrial gauging and calibration applications. The following are our most popular Am-Be industrial sealed sources" (QSA Global, 2026). All the listed sources are doubly encapsulated in 316L-stainless steel.

- "There is no evidence to support the assertion that this isotope arrived as an encapsulated source" (APR, 2026a, PDF p. 11). SC&A discussed this in the preceding bullet. DOE (1994a) lists the source as sealed.

- "Sealed Am-241 sources are considered a risk primarily because their alpha particles, when stopped by the seal if indeed it was encapsulated, are extremely dangerous if inhaled or ingested. While the sealed source itself poses an internal hazard if breached, its alpha emission also presents a risk of lung cancer from inhaling dust, and its gamma emission can contribute to radiation exposure even when the source is intact" (APR, 2026a, PDF pp. 11–12).

  SC&A agrees with the first part of the APR (2026a) statement in the abstract, since inhalation or ingestion of material containing alpha particle emitting isotopes would present an internal radiation hazard, but there is no evidence that the seal around the Am-Be source at Pinellas was ever breached. A sealed source contains radioactive material permanently enclosed inside a strong, protective capsule that is designed so the radioactive material cannot leak out, spill, or spread. These sources are kept under strict control and routinely tested to ensure the capsule remains intact. Am-241 emits a 0.060 MeV gamma 36 percent of the time, and a sealed Am-Be source produces low-energy gamma radiation in addition to neutrons as the beryllium-9 absorbs an alpha particle. This creates an excited carbon-12 compound nucleus, which then emits a neutron and often de-excites through the emission of a characteristic prompt gamma at about 4.44 keV, which would be mostly absorbed by the encapsulation. The relatively low energy 0.060 MeV gamma, which would be somewhat attenuated by the encapsulation, would be detected by personal dosimetry of Pinellas workers along with photons from any other sources they might have encountered.

- "There is no evidence of any type of monitoring of americium at Pinellas Plant" (APR, 2026a, PDF p. 12).

  The Pinellas health physics program used external dosimeters to track radiation exposure. Since there was no evidence of americium contamination, external monitoring was the only type of monitoring that would reasonably have been needed.

2.6 Other radionuclides

Section VI of APR (2026a) notes that several additional radionuclides were listed in the Pinellas inventory, but their form, quantity, and monitoring information were not provided (APR, 2026a, PDF p. 12). APR (2026a) cites the DOL Site Exposure Matrix (DOL, 2024) and lists six radionuclides: californium (Cf)-252, carbon (C)-14, cobalt (Co)-60, cesium (Cs)-137, Kr-85, and nickel (Ni)-63. While not explicitly stated, SC&A believes the APR is suggesting that the lack of information provided on these radionuclides is justification for an SEC. Except for Cf-252, previous reviews—including the Pinellas technical basis documents, the SEC evaluation report, and the SC&A interim review report (SC&A, 2023)—have already evaluated all of these radionuclides. The following sections discuss each remaining isotope as they pertain to dose reconstruction at Pinellas.

2.6.1 Californium-252

The most common neutron sources, including ^{241}Am–Be and ^{238}Pu–Be, generate neutrons through an alpha-neutron reaction. In these sources, the radioactive isotope emits an alpha particle, which is absorbed by beryllium to form a compound nucleus that subsequently releases a neutron. In contrast, Cf-252 is one of the few radionuclides that undergoes spontaneous fission. Roughly 3 percent of its decays occur by fission, producing 3–4 neutrons per event; the remaining 97 percent proceed by alpha decay. Following fission, Cf-252 decays through a long chain of 16 daughter isotopes before reaching stable lead-208, with each daughter emitting alpha or beta particles that are contained by the source encapsulation. Cf-252 has a high neutron yield: approximately 2.3–2.4×10^{12} neutron per second per gram, or 4.4×10^{9} neutron per second per curie (NRC, 2026, slide 30).

Pinellas had an Active/Passive Neutron Examination and Assay (APNEA) system employing a Cf-252 source as well as three calibration sources (one of which was a much smaller Cf-252 source) beginning in 1966. Since the APNEA system does not appear to have been mentioned in any of the NIOSH documents consulted, SC&A decided to investigate further to see if its presence could have represented an unaccounted-for source of exposure. As the APNEA name implies, it was intended primarily to interrogate waste drums for the presence of fissionable material. Martin Marietta (1996) describes the purpose of the APNEA system:

> The APNEA system measures the spontaneously fissioning and neutron fissionable material in nuclear waste drums. It will be mounted in a trailer and transported to various Department of Energy (DOE) sites to assay DOE waste drums for TRansUranic (TRU) material. APNEA first measures the spontaneous fission neutrons emerging from the drum, then uses a Zetatron [discussed later in this report] neutron generator to measure neutron fissionable waste material. The induced fission neutrons are distinguished from Zetatron neutrons by timing. A [*sic*] external matrix probe (EMP) ^{252}Cf neutron source with a strength of about 10^7 neutrons/sec is also used to measure the neutron transmission of the drum. . . . Currently, construction of a prototype APNEA, funded by the Technology Deployment Center, is occurring in Area 336. No nuclear waste drums will be present at Specialty Components [Lockheed Martin Specialty Components Pinellas Plant]. Instead, simulated waste drums will be constructed of encapsulated sources and uranium contained in small containers. [Martin Marietta, 1996, PDF p. 1]
>
> . . .
>
> The APNEA chamber has extensive shielding that performs the dual function of shielding its neutron detectors from background and shielding personnel from the neutrons emitted by APNEA's two significant neutron sources – a Zetatron generator of 14 MeV pulsed neutrons (~ 10^8 neutrons/sec) and a EMP ^{252}Cf neutron source (~10^7 neutrons/sec). [Martin Marietta, 1996, PDF p. 6]
>
> . . .
>
> In addition to the ~ 10^7 neutrons/sec EMP ^{252}Cf source, there is an ~ 10^4 neutrons/sec ^{252}Cf source. This smaller source has a radiation output of only 0.1 mrem/hr [millirem per hour] at 1-foot and is attached to a device which allows manual handling with negligible exposure. There are two additional ~ 10^4 neutrons/sec sources used to simulate nuclear waste. These will be positioned in simulated waste drums which will be measured by APNEA. One source is ^{241}Am-Be and the other source is ^{241}Am-Li [americium-lithium]. The neutron sources used for APNEA are doubly encapsulated Department of Transportation (DOT) special form. The EMP ^{252}Cf 10^7 neutrons/sec source will be locked into its shipping/storage container when not in use. The three small neutron sources will be stored in their shield containers in a locked cabinet in the trailer when not in use. [Martin Marietta, 1996, PDF p. 7]

Martin Marietta (1995b) establishes that Pinellas staff characterized and measured the radiation around the simulated waste containers:

> During the period from May 2 to May 23, 1966 radiation measurements were taken in Area 336 at LMSC [Lockheed Martin Specialty Components] around the APNEA system. The main purpose of these measurements was to locate and quantify the maximum radiation exposures produced by APNEA during operation. This work was separated into two parts: (1) characterization of APNEA due to the radiation produced by the Zetatron; (2) characterization of APNEA due to the presence of the ^{252}Cf source.
>
> The procedures for these two parts were given in memo "APNEA_RLB_019" dated May 1, 1996 (Zetatron Characterization) and in memo "APNEA_RLB_020 dated May 22, 1996 (Californium source characterization). [Martin Marietta, 1995b, PDF p. 44]

Lockheed Martin (1966), "Procedure to Measure Radiation in Vicinity of APNEA from ^{252}Cf EMP Source," establishes the care that Pinellas took in safely handling this source of radiation:

> Neutron and gamma ray exposure rates produced by the APNEA External Matrix Probe (EMP) ^{252}Cf source will be measured in area 336 to confirm radiation exposure calculations. The source strength of the EMP ^{252}Cf source is about 1.2×10^7 neutrons/sec resulting in an unshielded exposure rate at one meter of 12 mrem/hr neutrons plus 0.8 mrem/hr gamma rays. . . . As soon as practical after completion of the radiation survey, the ^{252}Cf source will be transferred to its shipping container and returned to building 800. [Lockheed Martin, 1966, p. 1]

Lockheed Martin (1996, PDF p. 2) lists a 2.3×10^{-6} Ci Cf-252 calibration source and states that it may be stored and used only in Building 800 and in Building 100 Areas A336A and A327.

Lockheed Martin (1966) contains detailed procedures concerning radiation protection measures before, during, and after operations, as well as for moving the Cf-252 shipping container from one location to another. For example, it requires practice using a dummy source, radiation monitoring, interlocks, utilization of training personnel, and participation of health physicists. It also mentions that an Am-Be neutron source is used to check the neutron monitors as part of the preparation procedures (Lockheed Martin, 1966, p. 7).

Martin Marietta (1995b) contains information about the form in which the Pinellas Cf-252 appeared:

> The 3014 [a type of stainless steel] capsule is designed to provide a point source of neutrons only, since the wall thickness of the doubly encapsulated fusion-welded container prevents emission or leakage of fission fragments. Therefore, no alpha particles, Auger electrons, capture electrons, or fission fragments, contribute to external irradiation on contact, [*sic*] only the average energy 2.35 MeV, isotopically emitted neutrons are an ionizing radiation hazard on contact. [Martin Marietta, 1995b, PDF p. 8]

The document later lists the Cf-252 activity as 185 kilobecquerels (5 μCi) and states that "the activity is contained in a ceramic or cermet pellet about 1 mm^3 [cubic millimeters] in volume located in the geometric center" (Martin Marietta, 1995b, PDF p, 9).

Lockheed Martin (1996, PDF p. 2) lists the Cf-252 calibration source activity as 2.3×10^{-6} Ci and Martin Marietta (1995b) as 5.0×10^{-6} Ci. It is not clear that they are referring to the same source, or whether they are talking about two different sources, but, in any event, the Cf-252 calibration source strength is a few microcuries.

The neutron yield of the large APNEA EMP Cf-252 source is given by Martin Marietta (1996) as approximately 10^7 neutrons per second (n/s) and by Lockheed Martin (1966) as 1.2×10^7 n/s. The latter value will be converted into activity in curies using the conversion factor of LLNL (2014, p. 3) of 1 microcurie (μCi) of Cf-252 yields 4,316 n/s. Then, the 1.2×10^7 n/s source is equivalent to 2.78×10^{-3} Ci. As a check, NRC (2026) gives the conversion factor of 4.4×10^9 neutrons per second-curie, which then gives an activity of 2.73×10^{-3} Ci for the APNEA Cf-252 source. This is about 1,000 times higher neutron yield than the Cf-252 calibration source.

Several of the preceding documents (e.g., Martin Marietta, 1995b, 1996) mention that the Pinellas assay system had an associated Zetatron, which the Pinellas TBDs and evaluation report do not mention, with a pulsed 14-MeV neutron emission rate of 10^8 n/s (Martin Marietta, 1996, PDF p. 6), in addition to the APNEA EMP system. SC&A conducted some research to determine if a Zetatron could have been an unaccounted-for source of radiation. A Zetatron is a high-voltage vacuum-tube neutron generator that produces continuous or pulsed neutrons by accelerating deuterium-based ions into a target to trigger fusion reactions.

Zetatrons are manufactured by Thermo Fisher Scientific. A Thermo Scientific company product specification webpage for its P 211 neutron generator states the following:

> The Thermo Scientific P 211 is designed such that both the accelerating voltage and ion source are pulsed. This assures [*sic*] that no neutrons are produced between pulses. This feature is critical for applications that depend upon measuring the variations of neutron populations following the source burst. One such application is the assay of transuranic materials in waste. The P 211 tube was originally designed by Sandia National Laboratories and incorporates the Sandia-designed "Zetratron" neutron tube. Thermo Fisher Scientific is now the only manufacturer of the Zetatron neutron tube. [Thermo Scientific, 2008, PDF p. 1]

The product specification gives the neutron output as 1.0×10^6 neutrons per pulse and the neutron yield as 1.0×10^8 n/s at a pulse rate of 100 hertz. It also lists uranium and plutonium as the primary elements detected.

SC&A's takeaway from its investigation of Cf-252 at Pinellas is that both the APNEA system and the Zetatron, while not part of Pinellas's primary missions, were sources of neutrons at Pinellas but do not present any new or unusual radiation exposures not already present and monitored for at Pinellas.

2.6.2 Carbon-14

SC&A reviewed C-14 in its interim review report and agreed with NIOSH's assessment of its potential hazard:

> C-14 (49.5 keV average and 156.5 keV maximum beta energy) produces beta particles with energies greater than 15 keV and is thus considered an external beta radiation hazard. The plant used small amounts of this radionuclide as a tracer in some solvents. The ER [petition evaluation report] notes that the amount of C-14 at the plant is considered negligible, with little potential for external beta exposure to personnel. SC&A concurs. [SC&A, 2023, p. 22]

2.6.3 Cobalt-60

SC&A's interim review report discusses Co-60 along with several other isotopes:

> SC&A does not find that the presence of radionuclides Sr-90 [strontium-90], Co-60, and Tl-204 [thallium-204] in inventory presented an internal exposure risk that should have been monitored for by Pinellas. Among other isotopes, Sr-90, Co-60, and Tl-204 were listed as nonproduction radioactive sources in the site inventory (DOE, [1994a], PDF p. 117). All Co-60 and Tl-204 sources were listed as sealed sources, thereby not constituting an internal radiation hazard. SC&A is aware of a 100 millicurie (mCi) Co-60 source that was found to be leaking in 1961 (Forest, 1961, PDF p. 4). Sealed sources are typically kept under control and undergo routine testing to ensure the integrity of the seal. The leak was detected as part of these routine surveys and was corrected immediately; as such, it did not pose a sitewide internal exposure risk. [SC&A, 2023, p. 31]

2.6.4 Cesium-137

The SEC petition evaluation report briefly discusses cesium: "Radionuclides other than the tritium and Kr-85 were mostly limited to sealed and plated check sources, static meter sources, sources used in instruments to detect combustible gasses, heat sources, calibration sources (Cs-137 was the most common sealed source) [Weaver, 1995, PDF p. 2], thickness gauges, gas chromatograph sources, dew point measurement sources, and static eliminator sources" (NIOSH, 2021, p. 32).

The ER later says, "The Pinellas Plant did not normally assess electron exposures in Building 800, where they calibrated portable radiation dose-rate instruments, unless there was an accident with the sealed 120 Ci Cs-137 calibration source. The sealed source was in a shielded cabinet in the concrete Building 800 [ORAUT [2017], PDF p. 11; GE 1971–1984, PDF pp. 81–86)" (NIOSH, 2021, pp 38–39).

A preliminary safety analysis report indicates that the 120 Ci Cs-137 calibration source was kept in a facility for the calibration of portable radiation measuring instruments; the source itself would be stored in a lead shielded container (GE, 1972). The report also states the following:

> Portable radiation dose-rate instruments will be calibrated by placing them in known fields of radiation above the port of the source container. Dose-rates will

> be varied by positioning lead absorbers of various thicknesses over the calibration port. The manipulation of absorbers and instruments will utilize remote handling devices to minimize radiation exposures. [GE, 1972, PDF p. 5]

2.6.5 Krypton-85

SC&A reviewed Kr-85 in several places in its interim review report, reproduced here for convenience:

External dose:

> Kr-85 (251 keV average and 687 keV maximum beta energy) poses a greater external beta exposure hazard than tritium because its beta particles have sufficient energy to cause a skin dose through exposure to a cloud of the gas. The plant used Kr-85 in leak detection systems. Although the plant recovered most of the gas after each leak test, some of it might have escaped into the environment despite the two leakage detection systems being surrounded by ventilation shrouds. However, SC&A's investigation of documented incidents at the plant found no instances of a cloud release of Kr-85. [SC&A, 2023, p. 22].

Internal dose:

> According to the State of Florida Department of Health and Rehabilitative Services, a total of 846 Ci of Kr-85 was released from the plant stacks from 1963 through 1992 (DOE, [1994a], PDF p. 42). Kr-85 is a colorless, tasteless, radioactive noble gas that decays by beta emission to rubidium-85, a stable isotope. As a noble gas, it does not react chemically within the body when it is breathed in and out. Although a minute amount of decay can be expected in the lungs (10.8-year half-life), Kr-85 primarily represents only a potential external hazard. . . . SC&A concurs with NIOSH's assessment in section 5.2 of the ER that this isotope [Kr-85] does not pose a significant internal hazard. [SC&A, 2023, pp. 30–31]

2.6.6 Nickel-63

SC&A's interim review report mentions Ni-63 as one of the radioactive isotopes present at Pinellas: "Nickel-63 (101-year half-life), used in krytrons (sealed, gas-filled glass tubes that were used as very high-speed switches in nuclear weapons), is a beta emitter" (SC&A, 2023, p. 18). Finding no information to the contrary, SC&A believes that Ni-63, which is commonly found in laboratories with radiation detection instrumentation as NRC exempt sources, was present at Pinellas as a sealed instrumentation and dosimeter calibration and check source and/or an analytical standard for laboratory analyses. As such, it would not require any special monitoring.

3 Other Work Group Issues Raised at the January 2026 Meeting

SC&A reviewed the transcript of the January 29, 2026, WG meeting (ABRWH, 2026) to identify any concerns expressed by the Board members in addition to those addressed in APR (2026a). The preceding sections of this report discussed WG concerns mirrored by or directly related to the APR concerns. Sections 3.1–3.6 discuss other WG concerns not raised by the APR.

3.1 Radioisotope thermoelectric generator end use

As previously discussed in this report (section 2.1.3.1.1), Pinellas received encapsulated Pu-238 heat sources from various DOE facilities, constructed RTG units in the 25-milliwatt range (*RTG Heat Sources*, 1983) and then shipped them to other DOE facilities. The documents concerning the RTG shipments from Pinellas to other DOE facilities do not indicate the end use of the RTGs. However, regardless of the end use (permissive action link (PAL), etc.) the handling and control of the encapsulated heat sources would be same for any of the RTGs produced at Pinellas. The particular use of the RTGs (e.g., for PAL systems, as discussed in section 3.3) would not impact dose reconstruction at Pinellas.

3.2 Pinellas contracts

SC&A reviewed many of the documents contained in the APR's data files (2026c), which included three folders in the "DOE Agreements" file plus 17 folders listed individually as "PINELLAS CONTRACTS FOLDER," for relevance to executed contracts that could indicate potential radiation exposures. SC&A found that most of the documents were not related to contracts; i.e., the documents contained proposals, publications, articles, etc., but not necessarily direct reference to executed contracts. SC&A found that many of the documents contained subject matter that would not indicate they involved potential radiation exposures. Some of the documents described the nuclear weapons program and facilities in general, with Pinellas listed as appropriate, but no new specific technical data applicable to dose reconstruction at Pinellas. For example, the article "Survey of Weapon Development and Technology (WR70) (U)" by Sandia National Laboratories (1998) was listed in the APR's data files (2026c), in folder "PLUTONIUMRTG FOLDER 8," but it contains only general information concerning weapons development.

DOE sometimes used the Pinellas Plant to develop new concepts, test, or modify components of nuclear weapons; a WG member referred to it as a "think tank for DOE" (ABRWH, 2026, p. 41). That might be an accurate description. However, SC&A's search through documents in the SRDB and APR's data files did not reveal any unusual or off-normal contracts or agreements that would suggest activities leading to radiation exposures outside those covered by Pinellas's radiation protection and monitoring programs. Therefore, such activities occurring on site, while interesting, would not impact NIOSH's ability to perform dose reconstructions for Pinellas workers.

3.3 Permissive action link

A Board member expressed concerns about documentation they located that references the PAL systems (ABRWH, 2026). The Board member believes that the presence of PAL systems in combination with bulk plutonium indicated that they were making heat sources at Pinellas. This is partially based on the incorrect interpretation of shipping documentation discussed previously in sections 2.1.3.1.1 and 2.1.3.2.1. To date, no credible information supports the notion that there was loose plutonium on site at Pinellas.

The PAL was developed in the early 1960s for the U.S. Atomic Energy Commission and the Department of Defense, mainly by Sandia National Laboratories, Mound Laboratory, and LANL. A PAL is an access control security device for nuclear weapons whose purpose is to prevent unauthorized arming or detonation of a nuclear weapon. It is included in or attached to a nuclear weapon system to preclude arming or launching until the insertion of a prescribed discrete code or combination of codes are entered.

SC&A reviewed documents concerning PAL systems and found information about their power sources as follows:

- Self-contained power sources are used in PAL systems to prevent unauthorized control through tampering with an external power source.
- Early PAL systems used an RTG that supplied electrical power in the milliwatt range. The thermal energy came from a Pu-238 heat source composed of Pu-238 oxide granules, which were enclosed within three layers of encapsulation (LANL, 2006).
- RTGs were developed and constructed at various DOE facilities.
- Pinellas produced RTGs and complex coded switches for the PAL systems.
- Later PAL systems used batteries for electrical power.

Although PAL systems and their power supplies were developed at several DOE sites, they were installed in nuclear weapons during assembly at facilities such as Pantex. As noted in section 3.1, the eventual use of some RTGs produced at Pinellas has no bearing on the adequacy of the site's radiation-protection program or on the ability to reconstruct worker doses. The presence of PAL-related documentation also does not imply that heat sources were being assembled at Pinellas.

3.4 Worker interviews

A Board member questioned if worker interviews had been conducted for the site and if SC&A had participated. SC&A can confirm that interviews were conducted with former workers in several formats. Several individuals were interviewed multiple times.

On November 2, 2004, ORAU hosted two meetings with former Pinellas workers to gather information for the development of a Pinellas site profile (SC&A, 2004–2020). The first meeting had 52 registered attendees and the second 18. On November 2, 2005, ORAU hosted two additional meetings with former workers to discuss radiation exposures at Pinellas and the site profile (PDF p. 22). The first meeting had 61 registered attendees and the second 17. Numerous individuals attended meetings on both days. These meetings also had representatives from NIOSH and ORAU present. No Board members were present, and SC&A did not participate in these meetings.

The Department of Labor hosted two DOL Site Exposure Matrices roundtable meetings on July 13, 2006 (SC&A, 2004–2020, PDF p. 269). Eighty-six individuals were invited to attend the meetings, but only 26 attended. No representatives from NIOSH, the Board, or SC&A were present at these meetings; however, formal notes were taken to summarize discussions.

Additionally, NIOSH and SC&A conducted 12 worker interviews on January 24–25, 2012. These interviews included two SC&A representatives, one NIOSH representative, and one former Board member. Participants included Building 400 workers with plutonium bioassays, health physicists, engineers, and trades personnel (SC&A, 2004–2020, PDF pp. 84–444).

NIOSH and ORAU also conducted 19 interviews between 2007 and 2021 that are summarized in appendix C of SC&A (2023). Contrary to the statement in that appendix, only ORAU and NIOSH representatives attended these SEC-specific interviews.

In addition, SC&A reviewed 490 computer-assisted telephone interview (CATI) reports as part of its initial assessment of the Pinellas SEC petition evaluation report. NIOSH provided SC&A access to the employee and survivor CATI reports available at the time of the 2023 review. SC&A examined these interviews for evidence of internal or external monitoring and any reported incidents and associated follow-up actions.

3.5 Size of health physics department

Board members expressed interest in understanding the size of the Pinellas health physics organization (referred to as "radcon" during the meeting) and its capacity to adequately monitor radiation exposures throughout plant operations (ABRWH, 2026, pp. 38–44).

The size and structure of the health physics function evolved over the operational history of the site. In the early years, health physics was integrated into a broader industrial health program. In 1962, this program comprised 13 personnel responsible for industrial medicine, health physics, industrial hygiene, and sanitary inspections (DOE, 1963, PDF p. 19). Although two health physicists were listed among survey contacts, the exact size of the dedicated health physics staffing at that time was not explicitly stated. A 1963 DOE survey nonetheless commended the site for establishing a Committee for Radiation Control, which met monthly to evaluate health physics issues and initiate corrective actions (DOE, 1963, PDF pp. 9–10).

By the mid-1980s, significant staffing transitions occurred. In October 1984, Pinellas's long-serving Health Physicist of more than 20 years retired, followed shortly by the retirement of a senior health physicist and an Environmental Safety and Health manager who had supported the program (DOE, 1985, p. 189). These departures left the program staffed by only one health physicist and one technician. A DOE health physics technical appraisal in June 1985 found the remaining staff to be qualified and motivated but concluded that this level of staffing was insufficient to maintain an acceptable health physics program. In response, Pinellas hired a Certified Health Physicist in early 1986, and an advanced industrial hygienist received formal health physics training to provide backup support.

DOE audited the health physics program again in December 1986 (DOE, 1986). The audit concluded that management had taken effective steps to strengthen the program, noting that the contractor's performance demonstrated increased management awareness, support, and technical rigor. Overall, the program was found to meet the intent of applicable DOE orders, regulations, and standards.

Health physics staffing continued to evolve in subsequent years. In 1990, the department included two health physicists (one advanced and one senior) and two aides (DOE, 1990, p. 4). The program also received technical support from the Instrument Calibration and Maintenance Group, the Environmental Chemistry Laboratory, and the Vacuum Maintenance organization within Equipment Engineering. By 1994, the team consisted of a Radiological Control Manager, a Health Physics Group Leader, an advanced Health Physicist, and three support aides (DOE, 1994b, PDF p. 7).

A WG member raised concerns about the availability and responsiveness of the health physics department relating to an incident involving an alpha-radiation alarm in Area 400. According to the account shared during the meeting, guards initially had difficulty locating health physics support to verify that the area was safe and to silence the alarm. The WG member recalled that "it took three-and-a-half to four hours to finally get a hold of [the health physicist] to be able to come back out and silence the alarm" (ABRWH, 2026, p. 44).

SC&A reviewed available security logs and identified an August 26, 1990, incident that closely aligns with this description (General Electric Security Patrol, 1990). The WG member confirmed that this was the event he was referencing. Although heavily redacted, the report indicates that an alpha alarm activated at 18:54 on the east side of Building 400, prompting an evacuation. Environmental Health and Safety was called but did not answer. Security then reached a different health physicist, who initially assessed, based on a discussion with an onsite staff member present when the alarm sounded, that the alarm could be addressed the following morning. Because product was out and required securing, this was deemed infeasible. A health physicist traveled from home to the plant, determined the alarm was false, and silenced it at 20:35.

The total response time for this after-hours event was 1 hour and 41 minutes. While a faster response is always preferable, this timeframe is reasonable given that the incident occurred outside standard working hours and before the widespread availability of cellphones. Based on the location, alarm type, and associated security considerations, it is reasonable to conclude that RTG operations were involved. Because RTGs contain triply encapsulated plutonium and, under normal conditions, present only an external exposure hazard, it would not be appropriate to expect a health physicist to be on site overnight for what is considered a very low-probability release scenario.

3.6 Routine leak tests on sealed plutonium

Another question posed by a WG member was: Were plutonium sealed sources routinely leak checked? As has been discussed extensively with the WG, the triply encapsulated plutonium sources were all checked for contamination upon arrival at Pinellas. The process of checking for contamination using swipe tests mirrors the technique of checking for a leak on the source. Unlike sealed sources maintained in inventory for calibration purposes, these sources were part of production. It is unclear if additional checks occurred or how long the sources were on site prior to being added to an RTG.

4 Conclusions

SC&A's review of APR (2026a), the extensive materials submitted previously by the APR, and related issues raised by the WG does not alter the underlying technical foundation for the SEC determination for the Pinellas Plant. Across all radionuclides and process concerns raised, SC&A did not identify any new information that substantiates unmonitored or unaccounted-for radiological source terms of consequence or that introduces exposure pathways outside those already evaluated in previous NIOSH and SC&A reviews.

There is no credible evidence that uncontained plutonium was ever present at Pinellas. All available environmental, bioassay, operational, and historical documentation continues to support the long-established conclusion that plutonium arrived on site only in sealed, triply encapsulated heat sources and remained fully contained throughout RTG operations. Environmental data, isotopic ratios, internal monitoring records, and operational controls all reinforce this point.

Similarly, none of the APR’s assertions regarding uranium, special tritium compounds, americium-241, other radionuclides, or alleged undocumented projects demonstrate the existence of exposure scenarios that would preclude dose reconstruction. In each case, either the claimed condition is not supported by evidence or the source term involved is already addressed through established monitoring programs, technical basis documents, or site-specific data.

Therefore, the totality of evidence continues to support that doses for Pinellas workers can be adequately reconstructed with sufficient accuracy. The material provided by the APR does not introduce any unresolved technical gaps that would meet the statutory criteria for an SEC. SC&A will continue to consider any new material uncovered or presented to the Board in the future.

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