NIOSH Response to SC&A's Review of Remaining LANL SEC-00109 Internal Dose Issues for 1996–2005

Response Paper

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INTRODUCTION

This response paper provides analyses of the findings and observations presented in SC&A's *SC&A Review of Remaining Internal Dose Issues for the LANL SEC-0109 Addendum Period (1996-2000)* [SC&A 2024]. Note that despite the "1996–2000" years contained within SC&A's document title, their document and this NIOSH response paper cover the remaining Special Exposure Cohort (SEC)-00109 evaluation period from January 1, 1996, through December 31, 2005.

As noted in NIOSH's *Addendum to Los Alamos National Laboratory (SEC-00109) Special Exposure Cohort Evaluation Report* [NIOSH 2017], NIOSH has captured and assembled a large body of evidence indicating that throughout its history, LANL has operated a radiation protection program that has involved competent hazard assessment, effective workplace controls, and monitoring procedures and capabilities commensurate with exposure potentials associated with their work activities [NIOSH 2017, PDF pages 9–10]. Additionally, after years of data and document capture work, NIOSH has not found any evidence that unmonitored workers received doses above the 10 C.F.R. Part 835 100 mrem committed effective dose (CED)/year monitoring limit for any radionuclides present. This data capture work included targeted efforts to obtain specifics on how exotics hazards were assessed, handled, and monitored; occurrence and incident reports contents; interviews with LANL employees; and inquiries into 10 C.F.R. 835 implementation during the 1996–2005 evaluation period. Attachment One summarizes the Data Capture Requests performed for the LANL evaluation and the materials captured from the site per those requests. Data capture is further discussed within the Finding 7 analysis. Note that in this response paper, "100 mrem/year" is used to reference monitoring threshold requirements and bounding doses for unmonitored workers[1].

The *SEC-00109 Evaluation Report*, Revision 01, issued on August 13, 2012, recommended including an SEC class covering workers for the January 1, 1976, through December 31, 1995, portion of the 1976 through 2005 petitioned period. This recommendation was based predominantly on program coverage uncertainties associated with potential internal exposures of unmonitored workers who may have worked in proximity to "exotic" radionuclides [NIOSH 2012a]. Per the SEC-00109 petition, these workers originally included Service Support Workers (which include but are not limited to security guards, firefighters, laborers, custodians, carpenters, plumbers, electricians, pipefitters, sheet metal workers, ironworkers, welders, maintenance workers, truck drivers, delivery persons, rad technicians, and area work

[1] 10 C.F.R. Part 835 [1993] incorporated the recommendations of International Commission on Radiological Protection (ICRP) Publications 26 [ICRP 1977] and 30 [ICRP 1979] for the calculation of doses. The quantity of primary interest in that system was committed effective dose equivalent (CEDE). Site documents prior to 2007 referring to 100 mrem/year would be referring to CEDE. In 2007, DOE revised the rule to incorporate the newer recommendations of ICRP Publications 60 [ICRP 1991] and 68 [ICRP 1994]. With this update to the calculated dose came a change in terminology: The dose of interest became committed effective dose (CED). The Energy Employees Occupational Illness Compensation Program Act of 2000 requires this later system of dose assessment. Therefore, when discussing the application of 100 mrem/year as a bounding dose, CED is the appropriate quantity.

coordinators) who worked in any operational Technical Areas with a history of radioactive material use. For the 1976 through 1995 portion of the petitioned period, NIOSH recommended expanding the class to include all LANL workers based on uncertainties associated with establishing which LANL workers may have frequented which technical areas over time.

It was postulated at that time (2012) that although no evidence had been found indicating work during any part of the entire 1976–2005 evaluation period was improperly monitored, there was also a lack of "objective evidence" (documentary evidence) that LANL's well-established radiation program was indeed being applied to what was described as smaller scale, intermittent, and limited activities involving exotics [NIOSH 2012b]. As such, NIOSH recommended establishing a 1976–1995 SEC class and continuing the search for evidence that exposure potential from exotics was assessed for the remaining 10 C.F.R. Part 835 portion of the evaluation period (January 1, 1996, through December 31, 2005). The bases for the SEC recommendation are discussed further in the Finding 7 Analysis section of this response paper.

The evaluation of the remaining 1996 through 2005 period focused on obtaining additional evidence of program details and the program's application to the petitioned, unmonitored Service Support Workers cohort but also to any unmonitored workers who may have directly worked in, happened to be in, or were close enough to an area in which exotic radionuclides were present such that internal exposure to these radionuclides could have reasonably occurred. Ultimately, these sorts of worker identification determinations are evaluated on a case-by-case basis by project dose reconstructors utilizing guidance from site-specific technical basis documents, claimant interviews, and available claimant records.

ORAUT-RPRT-0101, BOUNDING INTAKES OF EXOTIC RADIONUCLIDES AT LOS ALAMOS NATIONAL LABORATORY

ORAUT-RPRT-0101, *Bounding Intakes of Exotic Radionuclides at Los Alamos National Laboratory* [ORAUT 2023a], was generated to report the results of a task NIOSH agreed to during a November 29, 2018, LANL Work Group meeting. That task was to determine the ability to bound 1996–2005 doses from exotic radionuclides using surface contamination survey data, air monitoring data, source term inventories, and personnel contamination monitoring data, as available. As discussed during the meeting, the air and survey data assessment might also support the claim that doses for unmonitored workers have remained under 100 mrem/year. Additionally, it was postulated during the meeting that if radionuclides of concern were known, it should be possible to use the monitoring data to calculate air concentrations that would potentially give an individual 100 mrem/year. SC&A first introduced this new approach while describing NIOSH's difficulties obtaining desired objective (documentary) evidence from the site [NIOSH 2018a, PDF pp. 39–47].

In SC&A [2024], SC&A details three findings and three observations regarding ORAUT-RPRT-0101.

SC&A Finding 1: Representativeness of contamination surveys and air sampling data

> *As NIOSH indicated, the evaluation of survey smear sampling and air sampling does not represent all facilities that potentially handled exotic radionuclides, nor are the data necessarily considered a random or representative sample within the three facilities evaluated. Likewise unknown are the radiological classifications of the areas the data represent.* [SC&A 2024, PDF p. 11]

NIOSH Finding 1 Analysis

SC&A Finding 1 is technically accurate since it is a rewording of the description in RPRT-0101 (see the "Section 1.1 Purpose" and "Section 3.0 Contamination Survey and Air Monitoring Data in Technical Areas 3, 48, and 53" portions of the report) [ORAUT 2023a, PDF pp. 7, 18–26]. As such, NIOSH agrees with SC&A's Finding 1. It is noteworthy that SC&A acknowledged in SC&A [2024] that "…the intent of RPRT-0101 was to provide a scoping illustrative analysis rather than a strictly quantitative one. The report emphasizes several times that the evaluation represents a weight-of-evidence argument…" [PDF p. 23].

Regarding the TAs chosen for analysis in RPRT-0101, these areas were selected based on known work with exotics as documented in captured facilities documentation as well as an interview conducted with LANL staff. NIOSH asked LANL staff during a May 21, 2019, conference call "…which area on the site do you feel has the greatest potential for exposure to MFAP [mixed fission and activation products]? Thorium? Neptunium? Other exotics?" [ORAUT 2019a, PDF p. 8]. LANL indicated the following: LANSCE (in TA-53) and TA-18 for MFAP, TA-48 for MFAP and thorium, and Chemistry and Metallurgy Research (TA-3) for neptunium [ORAUT 2019a, PDF p. 8]. Furthermore, the RPRT-0101 analysis assesses routine contamination levels (i.e., surveys of laboratory hoods were excluded from the analysis). Radiological classification of the facility areas was not the primary driver for data selection which were: (1) known use of exotics and (2) surveys representative of typical (routine) contamination levels.

NIOSH's position is that, based on established procedures and processes, LANL implemented the necessary administrative and engineering controls to determine when and what type of internal dose monitoring was required to comply with the 100 mrem/year monitoring threshold requirement. This opinion is based on the evaluation of thousands of captured data and documents, interviews with LANL Radiation Protection personnel, and an absence of direct evidence to the contrary. Just a few examples of procedures and requirements include those available in *LANL Occupational Radiation Protection Requirements Laboratory Implementation Requirement LIR402-700-01.1* [LANL 2002], which covers 10 C.F.R. 835 requirements. Administrative controls are also discussed in this document on pages 24, 57, 86, 102, 117, 118, 130, 137, and 174. Engineering controls are mentioned on pages 57, 102, 106, 146, 168, and 193. Internal dosimetry is discussed on pages 53, 99, 179, 190, 191, and 197. Bioassay monitoring is discussed on pages 20, 47-54, 82, 131, 188, and 193. Section 2.1 of RPRT-0101 [ORAUT 2019a, PDF p. 9] summarizes workplace controls and provides examples of engineering controls. Captured radiation work permits (RWPs) also contain sections that specify administrative and

engineering controls, including radiological protection requirements such as personal protection equipment, respiratory protection, dosimetry, monitoring, training, and bioassay. Regarding bioassay, LANL used a health physics checklist form that workers completed jointly with their manager and an Environmental Safety and Health representative to document needed changes in the worker's in vitro, in vivo, and external dose monitoring programs [ORAUT 2021, PDF p. 15].

LANL's position relative to the monitoring threshold is that field monitoring programs would have identified radiological conditions that would require the submission of bioassay samples. The analysis presented in RPRT-0101 supports this claim. For example, Table 2-1 in RPRT-0101 presents contamination action levels excerpted from the LANL RadCon manual [ORAUT 2023a, PDF p. 13]. The survey data analyzed in RPRT-0101 provides evidence indicating that radiological conditions in routinely accessed areas were not sufficient to yield a dose greater than 100 mrem/year. As mentioned in the introduction, when reconstructing doses, worker identification determinations are evaluated on a case-by-case basis by project dose reconstructors utilizing guidance from site-specific technical basis documents, claimant interviews, and available claimant records.

Additional supporting document examples include *LANL Occupational Radiation Protection Requirements Laboratory Implementation Requirement LIR402-700-01.1* [LANL 2002], which notes additional requirements for the submission of bioassay samples. Contaminated wound monitoring is discussed on page 20, and special bioassay triggers (e.g., nasal contamination and workplace indicators) are discussed on page 52. Additionally, LANL's [redacted] provided information regarding the initiation of for-cause bioassay when field indicators suggested potential intake in unusual or upset conditions [LANL 2020, PDF p. 5]. In responding to Data Capture Request FY22-003, this same LANL employee provides information regarding the methodologies used to identify what work activities would likely result in 100 mrem CED [LANL 2022a, PDF pp. 6–8].

SC&A Finding 2: Completeness of contamination surveys and air sampling data

> *As NIOSH has affirmed in RPRT-0101, the dataset is not complete. Without some form of secondary source to know how many survey swipes and air sampling results were measured in the areas of interest, it is not possible to establish the level of incompleteness with the data forming the weight-of-evidence argument for 100 mrem.* [SC&A 2024, PDF p. 11]

NIOSH Finding 2 Analysis

SC&A initially expressed a potential concern with air sampling completeness during a July 25, 2019, LANL Work Group meeting [NIOSH 2019, PDF pp. 19–21].

NIOSH agrees with SC&A Finding 2 as stated. Like Finding 1, Finding 2 is largely a rewording of NIOSH's description of completeness limitations when NIOSH stated in Section 1.1 of

RPRT-0101, "NIOSH makes no claim that these data are complete. The goal of this report is to produce a qualitative analysis of these data." [ORAUT 2023a, PDF p. 11]. Notwithstanding the approximately 106,000 samples assessed in RPRT-0101, the evaluation was not a formalized study used to make statistical inferences regarding the monitoring limit. NIOSH used the data that were available. It cannot be said that the assessment is biased towards areas that are "cleaner" than others. Taken in total, however, qualitatively, the contamination survey and air sampling results are evidence that LANL's radiation protection program procedures and practices existed and have controlled radiological contamination and exposure potentials from January 1, 1996, through December 31, 2005. As noted in SC&A [2024], "… nearly all instances showed that 1 percent or less of the data were above the 100 mrem modeled limitation." [PDF p. 36]. The exceptions were TA-53 air monitoring results from 1996 and 1997, for which ~33 percent and 22 percent (respectively) exceeded the 100 mrem limit. These air samples are discussed in the Observation 3 Analysis section below.

By nature, weight-of-evidence determinations are ultimately subjective, and they simultaneously incorporate many different information sources and considerations (i.e., data quality and data quantity). In addition to the large number of data examined, the quality of the data is sufficient for evaluating LANL's radiation protection program quality and site experts' assertions. Furthermore, coupling the data evaluated in RPRT-0101 with other information sources presented, such as radiation program characteristics (e.g., general workplace controls, contamination spread prevention, etc.), additionally supports a weight-of-evidence-based conclusion that unmonitored worker doses from exotic radionuclides would not likely have exceeded 100 mrem/year.

SC&A Finding 3: Routine monitoring instructions do not encompass the entire evaluation period

> *Examples of routine monitoring instructions intended to demonstrate contamination surveying and air monitoring responsibilities were dated as taking effect in the year 2000 or later (except the one for TA-48, which was effective July 1997). Additionally, examples of incidents in 1996 with fixed monitoring stations used to control contamination at location entrances were for TA-55, which is the plutonium facility and may not be representative of the facilities where exotics were handled.* [SC&A 2024, PDF p. 11]

NIOSH Finding 3 Analysis

NIOSH agrees with SC&A's temporal and locational assessment of the available routine monitoring instructions. NIOSH also agrees that RPRT-0101 references an incident report for TA-55; however, incident reports for the three primary focus areas (TAs 3, 48, and 53) are also provided in RPRT-0101. As stated in responses to SC&A Findings 1 and 2, available data were necessarily evaluated qualitatively to assemble a weight-of-evidence-based assessment of LANL's radiation protection program sufficiency.

Routine monitoring instructions were used to describe area external radiation survey frequencies as well as air monitoring requirements. Survey frequencies could range anywhere from daily to annually. NIOSH has captured relatively few radiation monitoring instructions. The radiation monitoring instructions that have been captured were done so during general, wide-scope onsite data collection activities and via the site's response to Data Capture Request (FY23-005), which included a more targeted request for 1996–2005 routine monitoring instructions associated with TA-53 [ORAUT 2012–2024, pp. 166–168]. The captured routine monitoring instructions were presented as examples of this aspect of LANL's surveying and air monitoring process**.** Note that NIOSH has also captured documentation demonstrating routine monitoring instruction use at LANL at least as early as 1978 [LANL 1978, PDF p. 30]. Also noteworthy is an April 18, 1996, LANL letter [LANL 1996] containing a large list of radiation program procedures in place during that period, including one titled "Preparing, Reviewing, and Revising Routine Monitoring Instructions." Additionally, the captured document "Los Alamos National Laboratory 10 C.F.R. 835 Radiation Protection Program Document Evidence (Matrix)" (approved by DOE in 1999) provides extensive lists of LANL's approved procedures in place used to implement 10 C.F.R. 835.401(a)(1) through 835.401(a)(6) requirements. These requirements address the monitoring of individuals and areas [LANL 2022d, PDF pp. 77–83].

Though NIOSH has not captured a large number of routine monitoring instructions, they have also found no evidence that the survey requirements for routine monitoring instructions were not typically performed. Nor have they found any evidence that the requirements to assess and monitor worker radiation exposure potentials via regular surveys and air monitoring (per LANL's radiation protection program procedures) were routinely ignored, compromised, or applied differently to any individual TAs or work activities during the 1996–2005 period. NIOSH has collected over 39,000 survey results and over 66,000 air monitoring results for the three focus TAs within RPRT-0101 [ORAUT 2023a, PDF p. 25]. This is further evidence of the routine nature of the implementation of these types of monitoring. As such, not having more examples of LANL's actual routine monitoring instructions does not change NIOSH's conclusion that proper monitoring of work areas did occur and that unmonitored workers were unlikely to have received greater than 100 mrem/year.

SC&A Observation 1: Specification of worker job types for 100 mrem/year approach

> *SC&A believes a clear specification of the worker job types and radionuclides covered by the 100 mrem approach is warranted for work group discussion to clearly distinguish between the RPRT-0101 approach and any future development of co-exposure models for unmonitored workers who should have been monitored or whose records are unavailable.* [SC&A 2024, PDF pp. 11–12]

NIOSH Observation 1 Analysis

The *SEC-00109 Evaluation Report*, Revision 01 defines "exotic radionuclides" as being radionuclides other than uranium, plutonium, tritium, americium, and cesium. The varying references to exotics used in RPRT-0101 are only intended to better reflect differences in the

radionuclides, activities, and exposure scenarios expected to be associated with the different areas assessed. They are not intended to redefine "exotics" as originally defined in the *SEC-00109 Evaluation Report*, Revision 01.

As described in RPRT-0101, NIOSH concluded that no unmonitored workers received a dose above 100 mrem/year during normal operations [ORAUT 2023a, PDF p. 30]. Ultimately when reconstructing doses, determinations are evaluated on a case-by-case basis by project dose reconstructors utilizing guidance from site-specific technical basis documents, claimant interviews, and available claimant records. Additionally, information related to application of the bounding dose will be added to the applicable section of the Site Profile (e.g., Internal Dose section, Co-exposure section). ORAUT-RPRT-0107, *Dose Estimation from Intakes of Exotic Radionuclides at the Los Alamos Neutron Science Center, 1996 to 2005* [ORAUT 2023b], presents a potential method for bounding internal dose from exotics based on those radionuclides measured with a whole body count. Information from this report will also be incorporated into the relevant sections of the LANL Site Profile.

SC&A Observation 2: Duplicate entries in dataset

> *SC&A observed entries in the original dataset that were marked as duplicates but do not appear to have been deleted. However, given the small relative percentage and their observed relative magnitude, deleting these samples would likely have a minimal effect on the results.* [SC&A 2024, PDF p. 12]

NIOSH Observation 2 Analysis

ORAUT-RPRT-0101, Rev. 01 addressed these duplicates and other discrepancies. As noted in Section 1.1 of the revision: "The ORAU Team produced a QA outline and data entry instructions to facilitate the use of these data…The ORAU Team compared the data from the first and second data entries and resolved differences" [ORAUT 2023a, PDF p. 10].

SC&A Observation 3: Air sample results above 100 mrem limit in 1996 and 1997

> *Air sampling data evaluated for Technical Area 53 during 1996 and 1997 showed the highest number of observed results that were above the 100 mrem limit (~33 percent and 22 percent, respectively). This was significantly higher than all other technical areas and years.* [SC&A 2024, PDF p. 12]

NIOSH Observation 3 Analysis

NIOSH agrees with this observation. SC&A questioned the completeness and representativeness of the RPRT-0101 dataset in SC&A Findings 1 and 2. As such, this comment is correctly categorized as an observation, as NIOSH cannot make definitive statements regarding the implications of these results without statistical sampling.

The analysis of survey data presented in RPRT-0101 was not intended to assess temporal or spatial trends but rather was performed to support NIOSH's weight-of-evidence position. The accumulation of naturally occurring radioactive material likely explains the elevated alpha radioactivity present on air filters in TA-53. During a previous interview, LANL staff stated that any alpha activity reported on air sample filters was due to radon, thoron, and associated decay progeny [ORAUT 2023c]. LANL staff also noted that a short-term project involving Pu-242 was conducted at TA-53 during the period under evaluation, but no Pu airborne activity was measured. Furthermore, 7.2% of the RWPs evaluated by NIOSH for TA-53 listed actinides as the expected radionuclide [NIOSH 2024, PDF p. 5], indicating that the predominant radionuclides of concern were beta-gamma emitters. A compounding factor is that the air concentration limit is based on the most conservative radionuclide (Ac-227, Type F), which was not identified on any RWP or incident report utilized for this analysis. As a result of the conservative methodology used, calculations resulting in greater than 100 mrem/year exposure estimates due to naturally occurring radioactive material are not unexpected.

ORAUT-RPRT-0102, ASSESSMENT OF LOS ALAMOS NATIONAL LABORATORY PLUTONIUM BIOASSAY PROGRAMS, 1996 TO 2001

The evaluation and subsequent results detailed in ORAUT-RPRT-0102, *Assessment of Los Alamos National Laboratory Plutonium Bioassay Programs 1996 to 2001* [ORAUT 2021], were based on concerns first described in SC&A's *Review of SEC Petition Evaluation Report Addendum (SEC-00109) for Los Alamos National Laboratory* [SC&A 2017, PDF pp. 8–10]. In SC&A [2017], SC&A referenced the Noncompliance report NC ID 484, which describes a site RWP in which [redacted] workers listed were found to have not participated in the required bioassay sampling program [LANL 1999–2001, PDF p. 3]. This Noncompliance raised concerns and questions regarding bioassay data completeness in a more general, site-wide sense and over time. The concerns were discussed in most detail during the November 29, 2018, LANL Work Group meeting [NIOSH 2018a, PDF pp. 33–48]. The analysis presented within RPRT-0102 was performed to address concerns regarding bioassay completeness.

NIOSH notes that the conclusion of RPRT-0102 states: "The preponderance of evidence supports the conclusion that the plutonium bioassay data reported by LANL in the 1996 to 2001 study period include a significant portion of the most highly exposed workers and are therefore adequate to construct a co-exposure model for plutonium" [ORAUT 2021].

In their review of RPRT-0102, SC&A [2024] states:

> *Despite these findings and observations, SC&A believes that an appropriate co-exposure model for plutonium may be found acceptable. However, such a determination is a matter of professional judgment for the LANL Work Group and Board as a whole.* [SC&A 2024, PDF p. 50]
>
> *SC&A conditionally accepts that a co-exposure model for plutonium may be constructed for LANL for 1996–2005 based on the amount and availability of routine bioassay data*

> *for those years and its representativeness for exposure potential. Both the work group and SC&A had agreed in 2017 that there was a clear distinction between the availability of routine bioassay data for the primary radionuclides at LANL, including plutonium, and for nonroutine exposures to exotics.* [SC&A, PDF p. 96]
>
> *As noted earlier in this review, neither the work group nor SC&A has taken issue with the capability to dose reconstruct routine internal dose for the primary radionuclides (e.g., plutonium).* [SC&A, PDF p. 98]

NIOSH agrees with SC&A that dose reconstruction for primary radionuclides is feasible. NIOSH's specific responses to SC&A's three findings and three observations regarding ORAUT-RPRT-0102 are detailed below. Note that Findings 4 and 5 are addressed concurrently.

SC&A Finding 4: Single bioassay submission does not satisfy bioassay requirement for multiple RWPs

> *SC&A does not agree that an individual worker should be considered compliant with RWP bioassay requirements if ANY of the RWPs associated with that individual during the year have appropriate associated plutonium bioassays.* [SC&A 2024, PDF p. 12]

SC&A Finding 5: Selected time window for bioassay submission is not appropriate

> *SC&A does not believe the NIOSH assumption that an appropriate time window for bioassay submission of during the RWP work or by "the end of the year after the year in which the RWP expired" is an appropriate metric for assessing monitoring compliance with RWP-related work. In addition, SC&A does not believe instances where the EE submitted a plutonium bioassay during the RWP work necessarily satisfy the RWP-mandated monitoring criteria. SC&A believes the only appropriate time window for submission should be 1 year after the expiration of the RWP*. [SC&A 2024, PDF p. 12]

NIOSH Findings 4 and 5 Analysis

The following discussion is intended to clarify terminology related to LANL's bioassay program.

- "Routine," "special," and "prompt action" are the only types of urine samples identified in the LANL bioassay database. From 1996 to 2001, of the 12,666 plutonium urine and fecal bioassay samples:
  - 9,627 (76.01%) are designated as "routine."
  - 2,612 (20.62%) are designated as "special."
  - 427 (3.37%) are designated as "prompt action."

- Urine samples designated as "routine" are prescribed prospectively on the Health Physics Checklist (HPC) form before any work begins and are collected at times unrelated to any work being performed.

- Over 98% of all individuals on routine urine programs submitted 1 or 2 samples per year.

- Urine samples designated as "special" are prescribed in response to abnormal events in the workplace or as follow-up to known previous intakes of plutonium.

- "Prompt action" samples are special samples for exposure situations where the potential intake may result in CEDE that could approach administrative or regulatory individual limits [Inkret et al. 1998, PDF p. 4].

Note that none of the samples in the LANL bioassay database are marked as "job-specific" samples, and there is no mention of job-specific samples in the LANL plutonium internal dosimetry and bioassay programs document [Inkret et al. 1998]. Typically, in internal dosimetry, urine samples designated as "job-specific" means that the samples were collected due to the type of work being performed (per an RWP), but there were no abnormal events that would trigger the collection of a special sample. In other words, for job-specific sampling, the RWP drives the sampling program. SC&A refers to job-specific bioassay in SC&A [2024]. For example:

> *However, with access to available LANL RWPs for the period in question, NIOSH made a decision not to conduct the* ***RWP sampling for job-specific bioassay data*** *completeness and, instead, to review the routine bioassay database in hand.* [SC&A 2024, PDF p. 98, **emphasis added**]

> *However, as was noted during the 1999 LANL self-assessment, the auditors found that HPCs were not always submitted appropriately by some contractors (specifically Johnson Controls, LANL's construction and maintenance contractor) (Brackett & La Bone, 1999). It must be noted that the* ***RWP mechanism for collecting and analyzing appropriate bioassay is independent of the HPC/BEST procedures****; thus, the potentially incomplete nature of the HPC process does not affect the conclusions based on an analysis of the RWPs.* [SC&A 2024, PDF p. 37, **emphasis added**]

There is no evidence that LANL used job-specific sampling in the period under evaluation, and there is no sample designation of "job-specific" or any similar word(s) in the bioassay database or bioassay enrollment, scheduling, and tracking program (BEST) system. Thus, the statement that the RWP mechanism for collecting samples is independent of the routine sample collection mechanism (HPC/BEST) is inaccurate because there was no RWP mechanism to prescribe the collection of samples. SC&A [2024] also states:

> *From this review, one 1999 noncompliance stands out, NC ID 484, for which broad issues with the internal dosimetry monitoring program were cited, including 10 CFR 835.402(c)(1) violations involving incomplete bioassay checklists,* ***missing RWP job-***

> ***specific bioassays****, and shortcomings in construction trade worker bioassay enrollment.* [PDF p. 16, **emphasis added**]

The site audit [Brackett and LaBone 1999] that resulted in NC ID 484 did not use the language given in bold font. The audit only mentions job-specific bioassays in the Introduction[2] section, in a generic list of types of samples: routine, job-specific, special, and follow-up bioassays [Brackett and LaBone 1999, PDF p. 5].

A requirement for work that involved plutonium, as indicated on the RWP, was that the worker be on the "Plutonium Access List." This list verified that the worker was on a routine bioassay program for plutonium—the work did **not** trigger collection and analysis of the sample after the work was completed. An analogous requirement would be that the worker wears the appropriate external dosimeter before performing work under the RWP—the dosimeter is a prerequisite for doing the work. The work did not trigger the issuance of the dosimeter before the work nor the reading of the dosimeter after the work. There is no direct relationship between the timing of the bioassay sample request/submission and the start/stop dates of the RWPs. This is because the RWPs do not drive the plutonium bioassay program—the plutonium bioassay program is a prerequisite for doing work with plutonium (i.e., the plutonium program is routine, not job-specific). Therefore, it is difficult to make unambiguous statements about a routine bioassay program "complying" with the requirements of one or more RWPs. Note that:

- Workers were required to sign an RWP acknowledgment log within an RWP to indicate they understood the monitoring and personal protection equipment requirements of that RWP. RPRT-0102 considers a worker compliant if any of the RWPs "acknowledged" by that worker during the year have associated plutonium bioassays. Because these workers were on the Plutonium Access List and on a routine program, requiring all RWPs for a worker in a year to have associated plutonium bioassay would likely not change the conclusion in RPRT-0102 (SC&A Finding 4).

- Various "windows" for compliance with the RWP were used in RPRT-0102 [ORAUT 2021], and other windows might be reasonably considered. All such windows are arbitrary[3] to some extent and would likely not change the conclusion in RPRT-0102 (SC&A Finding 5).

- The only unambiguous metric is the number of plutonium samples requested and received in any given year (Figure 7-1 of RPRT-0102 [ORAUT 2021, PDF p. 23]), which is independent of the RWPs.

[2] The language in the introduction of the audit is drawn from a letter from the Director of the Office of Enforcement and Investigation dated November 24, 1998, to enact the moratorium on enforcement actions [Christopher 1998, PDF p. 4]

[3] A given urine sample will reveal whether significant exposures to plutonium occurred during all RWP work that occurred prior to the collection of the sample.

SC&A Finding 6: Assumption of similar exposure potential between workers acknowledging the same RWP is questionable

> *The assumed connection between exposure potentials for workers based solely on signing the same RWP acknowledgement form is questionable. This would be particularly true for RWPs that span a significant length of time and require individual workers to perform several different tasks with variable exposure potentials.* [SC&A 2024, PDF p. 12]

NIOSH Finding 6 Analysis

SC&A compares what was done with RWPs at LANL to what was done with RWPs at SRS. SRS RWPs included sign-in sheets that included department/task/craft, sign-in date and time, and sign-out date and time for each worker. LANL RWPs only included pre-job briefing acknowledgment logs that included employee organization (e.g., JC, ESH, NMT, etc.) and the date and time of acknowledgment for each worker. SC&A acknowledges this important difference [SC&A 2024, PDF p. 49].

ORAUT-RPRT-0092, *Evaluation of Bioassay Data for Subcontracted Construction Trade Workers at the Savannah River Site* [ORAUT 2019b], refers to the term "effective monitoring" which means that if a worker was not monitored, a worker on the same RWP, same date, same time (within no more than 15 minutes) who was monitored would make the unmonitored worker "effectively monitored." "Effective monitoring" percentages are reported throughout RPRT-0092, and the Conclusion sections rely heavily on "effective monitoring" percentages to justify being able to make co-exposure models for SRS.

RPRT-0102 defines a "workgroup" as all workers who signed the acknowledgment log within a particular RWP [ORAUT 2019b]. There was no attempt to analyze "effective monitoring" percentages for LANL "workgroups" because the information on the LANL acknowledgment logs makes that impossible[4]. Although SC&A refers to the "workgroup" discussion as "one of the major conclusions of RPRT-0102…" [SC&A 2024, p. 48], that discussion is only one paragraph and one plot at the end of Section 10.0 and is one of the many bullets in Section 12.0, Summary and Conclusions section. The focus of RPRT-0102, Section 10.0 is Table 10-1, not the "workgroup" discussion. The purpose of looking at the histogram in Figure 10-4 of RPRT-0102 was to see how frequently RWP acknowledgment logs contained no (or very few) monitored workers. Because that happened very infrequently, the "workgroup" discussion concludes by stating, "it is highly likely that workers who were exposed to plutonium and not monitored had potentially exposed coworkers who were monitored" [ORAUT 2021, PDF p. 31].

Just before Finding 6, SC&A [2024] states, "Therefore, any assumed connection between the exposure potential for workers based solely on signing the acknowledgement form is questionable" [SC&A 2024, PDF p. 49]. NIOSH agrees, but that is not what the "workgroup" discussion in RPRT-0102 attempted to explain. If workers were going to be working with

[4] LANL acknowledgment logs do not have department/task/craft information or sign-in (or sign-out) dates and times because the worker may never have even done work on that RWP.

plutonium, they had to be on the Plutonium Access List. The Plutonium Access List is how LANL ensured that workers with the highest exposure potential for plutonium were monitored, which suggests that a bounding co-exposure model can be made. If RPRT-0102 had not included the "workgroup" discussion, its conclusion would remain the same, "The preponderance of evidence supports the conclusion that the plutonium bioassay data reported by LANL in the 1996 to 2001 study period include a significant portion of the most highly exposed workers and are therefore adequate to construct a co-exposure model for plutonium" [ORAUT 2021, PDF p. 33].

SC&A Observation 4: Different compliance rates between two maintenance contractors

> *The lowest observed compliance with bioassay requests via the Bioassay Enrollment, Scheduling, and Tracking (BEST) system was for Johnson Controls, one of LANL's maintenance contractors, which had a low of ~45 percent compliance for 29 requests in 2001 (~72 percent compliance for all years). However, KSL Services, which appears to have been another maintenance contractor for LANL, had the highest rate of compliance observed overall (~89 percent) and was never lower than ~83 percent.* [SC&A 2024, PDF p. 12]

NIOSH Observation 4 Analysis

In Section 2.2.4.1 of SC&A [2024], SC&A states:

> *The lowest compliance percentage (~45 percent) was for Johnson Controls, one of the site's maintenance contractors, in 2001. However, this only represented 29 total requests. KSL Services took over LANL's maintenance contract beginning in 2003; SC&A assumes that KSL Service employees performed similar maintenance duties during the years of interest.* [PDF p. 41]

The KSL compliance percentage is higher than the Johnson Controls compliance percentage for every individual year and all combined years. KSL also collected more samples every year. NIOSH agrees with SC&A and given that KSL workers consistently submitted ~200 samples per year and were doing similar work as Johnson Controls, this observation does not point out a problem for co-exposure modeling.

SC&A Observation 5: Reasons for not submitting a bioassay are not legitimate

> *SC&A does not agree with NIOSH's contention that the large majority of unfulfilled bioassay requests (1,613 of 1,981) were for legitimate reasons (i.e., over 97 percent of bioassay requests were either correctly fulfilled or have legitimate reasons for going unfulfilled). It is SC&A's opinion that the only legitimate reason for an unfulfilled bioassay request is that the EE was not exposed to plutonium for the entirety of the intended monitoring period.* [SC&A 2024, PDF p. 12]

NIOSH Observation 5 Analysis

Whether or not it is acceptable to have an unfulfilled bioassay request is a regulatory issue, not a co-exposure issue. A regulator will want to know the reason for an unfilled request, which is why LANL kept track of the reasons sample requests were not fulfilled. For co-exposure modeling, the interest is in whether a requested sample was received (~86% were received) and whether the site monitored the workers with the highest exposure potential. Unless the unfulfilled requests included all the workers with the highest exposure potential (which is highly unlikely), the unfulfilled requests do not impact NIOSH's ability to construct a co-exposure model.

SC&A Observation 6: Open window approach does not guarantee that a subsequent co-exposure distribution would reflect the intake period

> *SC&A's objections regarding the acceptable time window for bioassay submission do not affect the RPRT-0102 estimates when considering an open window timeframe. However, SC&A notes that the later monitoring result, as used in a potential co-exposure distribution, is not guaranteed to be reflected in the intake period for which it is intended (i.e., it would be reflected in the year the sample was taken, not the year in which the exposure was incurred).* [SC&A 2024, PDF pp. 12–13]

NIOSH Observation 6 Analysis

SC&A states this position more clearly in Section 2.2.5.2 of SC&A [2024]:

> *However, it is important to note that a sample taken many years after the exposure may not actually be associated with the original exposure in the formulation of a co-exposure model. When calculating the TWOPOS statistic, the sample would be associated with the year it was taken rather than the year of exposure. If the two years are in different intake periods, for the purposes of calculating a resulting distribution, the meaningful connection between the exposure and sample are lost.* [PDF p. 48]

An external dosimetry co-exposure model models the doses received each year. The equivalent analysis in an internal dosimetry co-exposure model would be to model the radionuclide intakes for each year. This type of analysis is infeasible for plutonium and most radionuclides, so the bioassay data in each year are modeled. For long-lived nuclides, a urine sample contains activity from all previous intakes regardless of the year they occurred. Thus, all internal dose co-exposure models constructed to date are based on the year the bioassay was performed, not the year of the intake[5].

[5] Bioassay results are not independent, especially for long lived nuclides. They include material from all previous intakes, regardless of date.

ORAUT-RPRT-0103, REVIEW OF POTENTIAL EXPOSURE TO EXOTIC RADIONUCLIDES USING RADIOLOGICAL WORK PERMIT DATA AT LOS ALAMOS NATIONAL LABORATORY

ORAUT-RPRT-0103, *Review of Potential Exposure to Exotic Radionuclides Using Radiological Work Permit Data at Los Alamos National Laboratory* [ORAUT 2022a], is meant to supplement RPRT-0101 and provide additional evidence supporting the ability to bound doses for exotic radionuclides at LANL for the 1996–2005 period. ORAUT [2022a] provides detailed analyses of RWPs from [redacted] TAs known to have done work with radionuclides of concern. The analyses in RPRT-0103 support the premise that LANL monitored and assessed work activities in a manner that allowed them to determine which workers required bioassay monitoring.

In SC&A [2024], SC&A details three observations regarding ORAUT-RPRT-0103.

SC&A Observation 7: 22% of 147 workers under 34 RWPs were unmonitored

> *During the period of interest from 1996 to 2005, SC&A identified 34 RWPs covering 147 workers who had tritium bioassay specified. Of these 147 RWP-worker combinations, SC&A found that approximately 73 percent were appropriately monitored throughout the assumed job period, 5 percent were partially monitored, and 22 percent were unmonitored.* [SC&A 2024, PDF p. 13]

NIOSH Observation 7 Analysis

As noted in RPRT-0102:

> *Workers signed an acknowledgment sheet during the pre-job briefing, which was required before working under the RWP. The signature on the acknowledgment sheet indicated that the worker understood the monitoring requirements of the RWP [DOE 1998]. Note that a worker could have signed an acknowledgment sheet and never performed work under that RWP; it is not a sign-in sheet.* [ORAUT 2021, PDF p. 20]

As such, it would not be expected that the number of tritium bioassays completed would match the number of signatures on the RWP acknowledgment log. Therefore, the quotient of bioassays and RWP acknowledgment signatures is not the appropriate metric for assessing completeness.

Additionally, tritium bioassay enrollment is based on several criteria. These can be found in LANL's Internal Dosimetry Technical Basis document [LANL, no date]. The following is Section 2.2.4 excerpted from that document:

> *2.2.4 Tritium*
>
> *Participants in the routine urine monitoring program must submit a 500 ml sample for analysis every two weeks. Personnel performing regular or intermittent work with the*

following quantities of material (or on systems that have contained these quantities) are required to participate:

- *1 Ci of tritium in any form*
- *0.1 Ci of tritium oxide*
- *0.1 Ci of metal tritide*
- *0.1 Ci of organically bound tritium*

Single baseline urine samples are required upon enrollment in the routine bioassay program.

Employees who submitted routine urine samples for tritium analysis shall submit a termination urine sample, collected after they complete work in areas where tritium is handled. [LANL, no date, PDF p. 25]

SC&A Observation 8: Individuals working under an RWP were potentially under-monitored

SC&A identified a single RWP covering 10 workers that specified uranium monitoring in addition to plutonium urinalysis. [redacted] of the 10 workers did not have internal monitoring identified, [redacted] of 10 only had plutonium monitoring, and [redacted] had unclear records due to an undated chest count. [SC&A 2024, PDF p. 13]

NIOSH Observation 8 Analysis

The RWP (RWP-[redacted]) SC&A identified in Observation 8 [LANL 1999a] is not used in RPRT-0103 because it did not involve exotic radionuclides. Nevertheless, as stated previously, workers signed an acknowledgment log during the pre-job briefing, which was required before working under an RWP. The signature on the acknowledgment log indicated that the worker understood the monitoring requirements of the RWP [DOE 1998]. A worker could have signed an acknowledgment log and never performed work under that RWP [ORAUT 2021, PDF p. 20].

Section 2.2.3 of LANL's Internal Dosimetry Technical Basis document [LANL, no date, PDF pp. 24–25] provides criteria for uranium bioassay enrollment.

2.2.3 Uranium

Participants in the routine urine monitoring program must submit a 500-ml sample for analysis every two weeks. Personnel performing hands-on work in the following operations are required to participate:

- *machining or polishing uranium metal (any quantity) in open areas (as opposed to inside dry boxes);*

- *foundry work, including casting and cleaning crucibles (any quantity) in open areas;*
- *chemical operations, including purification and recovery using 10 g or more, in open areas, or where spills or leaks are frequent;*
- *operations with uranium hexafluoride (any quantity) in uncontained systems;*
- *handling heavily oxidized uranium metal or bulk powders of uranium compounds (100 g or more) in open areas;*
- *extrusion of hot uranium metal (any quantity) in open areas without respiratory protection; and*
- *operations or tasks, including physical maintenance of systems that contain uranium, where there is a significant potential for an intake of uranium corresponding to a CEDE of 100 mrem.*

Single baseline urine samples are required upon enrollment in the routine bioassay program, before beginning radiological work.

Employees who submitted routine urine samples for uranium analysis shall submit a termination urine sample, collected after they complete work in areas where uranium is handled. [LANL, no date, PDF pp. 24–25]

After reviewing RWP-[redacted] NIOSH found some results that are different from SC&A's observations:

- Energy Employee 1 – There were [redacted] *in vivo* bioassay results for [redacted] which is 259 days post-job versus the 595 days that SC&A used after the assumed end date.
- Energy Employee 6 – SC&A states there was no [redacted] *in vivo* monitoring data, but NIOSH found [redacted] *in vivo* monitoring data dated [redacted].
- Energy Employee 7 – SC&A states there were no [redacted] *in vitro* bioassay results, but NIOSH found [redacted] *in vitro* bioassay data dated [redacted]. SC&A also states that there was no [redacted]*in vivo* monitoring data, but NIOSH found [redacted] *in vivo* monitoring data dated [redacted].
- Energy Employee 9 – SC&A states that there was *in vivo* and *in vitro* bioassay [redacted] data. NIOSH did not find any [redacted] *in vivo* or *in vitro* bioassay data.

Note that ORAUT-OTIB-0062 Rev. 01, *Internal Dosimetry Co-Exposure Data for Los Alamos National Laboratory* [ORAUT 2020], contains plutonium and uranium co-exposure intakes for unmonitored workers during the 1996–2005 period.

SC&A Observation 9: Positive nasal smears with varied follow-up bioassays

> *SC&A identified 24 individuals with positive nasal contaminations and evaluated their internal monitoring records. The number of individuals with follow-up monitoring varied from 14 to 17 (58 percent to 71 percent) depending on certain assumptions about undated records and potentially invalid positive nasal swipes.* [SC&A 2024, PDF p. 13]

NIOSH Observation 9 Analysis

NIOSH acknowledges SC&A's observation and has seen examples similar to those presented in Table 27 of SC&A [2024, PDF p. 69]. Per LANL's Internal Dosimetry procedure, the activity present on a nasal swipe dictated whether or not a follow-up bioassay analysis was performed [LANL, no date, PDF pp. 27–29]. Table 1 below summarizes the nasal swipe activities that would require a follow-up bioassay. For example, if a nasal swipe had an activity less than 35 disintegrations per minute (dpm) for plutonium or americium (sum of activity collected from both nostrils), then a bioassay sample would not be collected. Therefore, it cannot be expected that the number of positive nasal swipes and follow-up bioassay samples would be equal.

Table 1. Nasal swipe activity threshold for collection of a special bioassay (dpm)[a]

Radionuclide	Special Bioassay	Special – Diagnostic Bioassay	Special – Prompt Action Bioassay
Uranium	≥ 100	[b]	[b]
Plutonium or Americium	[c]	≥ 35	≥ 100

[a] Source: [LANL, no date, PDF pp. 27–29]

[b] There is no special bioassay subtype for uranium

[c] Special bioassays for plutonium and americium have a sub-type of either diagnostic or prompt action.

Additionally, LANL generated Radiation Protection Observation Reports (formerly known as Radiological Incident Reports) if the sum of the readings in both nostrils for nasal swipes was greater than or equal to 50 dpm for alpha and/or greater than or equal to 500 dpm for beta [LANL 1998a, PDF p. 2].

Note that even though RWPs may list nasal smear requirements, the radiological control technician (RCT) and/or line management were given discretion as to whether the requirement could be relaxed due to radiological conditions before or as the work progressed. An example of this RCT authority is provided under the "Hold Point" section of RWP 99-033 [LANL 1999b, PDF p. 2,368].

OVERALL PROGRAMMATIC CONSIDERATIONS FOR INTERNAL DOSIMETRY AT LANL

In SC&A [2024], SC&A details two findings regarding overall considerations for internal dosimetry at LANL.

SC&A Finding 7: RPRT-101 and -103 don't demonstrate an unmonitored worker would receive less than 100 mrem CEDE

> *SC&A finds that RPRT-0101 and RPRT-0103 do not demonstrate that nonroutine job-specific bioassays were adequately evaluated for potential operational exposures to exotics, and that LANL monitoring programs were being adequately implemented to ensure that unmonitored workers were unlikely to receive intakes resulting in 100 mrem CEDE.* [SC&A 2024, PDF p. 13]

NIOSH Finding 7 Analysis

NIOSH has previously requested information from LANL specifically aimed at learning how the 100 mrem/year monitoring requirement was evaluated and implemented during the 1996–2005 period [LANL 2013a; LANL 2013b; LANL 2014; DOE 2015; LANL 2019; LANL 2021; LANL 2022a; LANL 2022b; LANL 2022c; LANL 2022d; LANL 2022e; LANL 2022f; ORAUT 2022b]. Examples of captured information include monitoring requirements and procedures, health physics checklists, area- and task-specific assessments and checklists, and interviews with LANL personnel. The information obtained consistently indicate that workplace hazards have been assessed and controlled and that LANL has maintained robust field monitoring programs capable of identifying situations where bioassays would have been required [LANL 2013a; LANL 2013b]. Following the complete evaluation of all captured documentation and LANL's site experts' statements, NIOSH concludes they can bound unmonitored dose by assigning 100 mrem CEDE for unmonitored workers (or can reconstruct dose with sufficient accuracy) for the evaluated class. The analyses presented in RPRT-0101 and RPRT-0103 supply additional evidence that implementation of 10 C.F.R. Part 835 monitoring limits have been maintained.

Regarding LANL's implementation of the monitoring limit, NIOSH has previously stated:

> *Although 10 CFR 835 contains a lot of nuances and implementation guides that may have come out too late to impact RPP development by January 1, 1996,* ***the important question is not overall implementation and compliance with 100 percent of 10 CFR 835, but rather, whether there was a program in place ensuring that unmonitored workers were unlikely to receive intakes resulting in 100 mrem CEDE****. This is a very narrow but important subset of 10 CFR 835. Although there were some bioassay deficiencies identified in LANL audits, NIOSH does not find that those issues preclude assigning two percent of the occupational exposure limit for workers as a bounding limit for workers who were not monitored.* [NIOSH 2018b, PDF pp. 7–8, **emphasis added**]

SC&A references the bolded portion of the above statement in SC&A [2024], suggesting that both NIOSH and SC&A agree that the (bolded) statement is the fundamental question related to implementing the monitoring threshold [SC&A 2024, PDF p. 84]. While NIOSH agrees with the significance of the stated concept, NIOSH and SC&A disagree on the necessary data inputs needed to satisfactorily conclude its evaluation. NIOSH's position is that the sizeable quantities of available information identifying LANL's evaluation of workplace hazards, workplace radiological conditions, and appropriate and adequate response to off-normal conditions (i.e., incidents) collectively constitute sufficient weight of evidence that LANL maintained a program able to identify higher exposure–risk workers needing monitoring, minimize exposure potentials to all workers, and ensure unmonitored workers were unlikely to receive intakes resulting in 100 mrem CEDE (or greater).

SC&A's most recent review indicates that because of past concerns with unknowns associated with exotic radionuclide dose reconstruction feasibility for the 1976–1995 period (presented in the SEC-00109 Rev. 01 Evaluation Report), and the continued presence of exotics in (limited) operations during the 1996–2005 period, LANL may not have identified all workers requiring internal monitoring during the remaining 1996–2005 evaluation period [SC&A 2017, PDF p. 14; SC&A 2024, PDF p. 83]. SC&A additionally supports this hypothesis by noting that there are few indications of significant radiological protection program changes from the early to late 1990s but some changes were implemented in the early 2000's.

It is important to remember that the 1976–1995 period was designated as an SEC class due to concerns within the LANL Work Group and SC&A that the site's seemingly well-established health physics program present during this time might, potentially, not have been similarly applied to intermittent, small-scale experimental work involving exotics. It was **not** designated an SEC because NIOSH actually had evidence indicating disparities in radiation program coverage. In fact, no definitive evidence indicating the existence of disparities in radiation program coverage has been found to date. NIOSH's concern at that time however was that "objective" evidence (documentary evidence) that the health physics program was indeed consistently applied to intermittent, smaller experiment-level work had not been captured. This, coupled with low availability of exotic radionuclide monitoring data supported making an SEC recommendation for this period. As NIOSH stated (in part) during a September 11, 2012, Work Group meeting:

> *But one of the main reasons we think is that the exposure to these exotics we could not demonstrate with any degree of confidence that the exposures were controlled and handled in a similar manner. Even though the health physics program seemed to be in place, it seems that these exotics which were not used on a routine basis would have been --could have had different types of exposure conditions present than what you would experience with the things like plutonium and uranium.*
>
> *So in other words, the exposure to the exotics, you know, might -- were on a much more intermittent experimental basis or very much episodic in nature that would preclude the*

> *use of this chronic exposure model that was developed for things like plutonium and uranium. And in addition, the short duration exposures that were established for these small experiments might not have had similar engineering controls. We just couldn't determine that to any degree of -- with any degree of confidence.*
>
> *So after reviewing all of that information we agree or we decided that we would -- Class should be added based on our inability to reconstruct doses for these exotics and mixed fission activation products from January 1st, '76, all the way through the end of December, '95. We reserve judgment to continue to review data after '95. We're not saying at this point that we've made a determination, but it appears to us that '95 is a -- is a good cut point based on the existence of 10 CFR Part 835, the establishment of a technical basis document for internal dosimetry and preparation of resolutions and responses to some Tiger Team concerns that were raised.* [NIOSH 2012b, PDF pp. 11–13]

NIOSH soon after during this same meeting explained that the 1976–1996 SEC designation would apply to all workers at the site due to the inability to determine who entered which work areas [NIOSH 2012b, PDF p. 14). Note again that the recommendation for the 1976–1995 SEC class was not based on knowledge or evidence of an insufficient monitoring program for that period, or for changes that were known to be necessary. It was recommended because of concerns that a hypothesized, potential disparity between how the established radiation program was being applied to longer term, larger work efforts versus smaller, short-term and intermittent efforts might be possible.

During SEC evaluation processes, NIOSH strives to be mindful of petitioner concerns, potential class members' concerns, Work Group and SC&A concerns, and the EEOICPA process requirements. Additionally, when NIOSH recommends adding a class to the SEC, NIOSH must select defensible end dates. As such, in 2012, NIOSH recommended making the 1976–1995 portion of the petitioned period an SEC class while continuing to evaluate the remaining 10 C.F.R Part 835 petitioned era (1996–2005). NIOSH deemed this cut-off point as the most defensible choice under a presumption of 10 C.F.R. 835 implementation while still being mindful of all parties concerned with and affected by the SEC-00109 evaluation process.

As described in this paper's introduction, the worker cohort focus for the remaining 1996–2005 period has been the petitioned, unmonitored Service Support Workers but similarly applies to any unmonitored workers who directly worked in, happened to be in, or were close enough to an area in which exotic radionuclides could have been present such that internal exposure from these radionuclides could have reasonably occurred. Note that ultimately these sorts of worker determinations are evaluated on a case-by-case basis by project dose reconstructors utilizing guidance from project technical basis documents, claimant interviews, and available claimant records.

Evaluation of the remaining 1996–2005 portion of the petitioned period has been largely focused on continuing to learn more about LANL's radiation program during this period. This has included efforts to learn how the site assessed exotic radionuclide exposure potential, monitoring need determinations, monitoring performance, and searching for the aforementioned "objective" (documentary) evidence that LANL's radiation program was appropriately applied to smaller, intermittent experiments involving exotics.

NIOSH's continued data capture efforts to further assess the 1996–2005 evaluation period yielded much additional information supporting the sufficiency of LANL's radiation protection program. A total of thirty-nine Data Capture Requests were executed during the continued 1996–2005 evaluation (see Attachment One). Examples of information requested include specific documentation showing how potential exposures to radionuclides (including exotics) are assessed; details showing how monitoring requirements are determined; shipments, receipts, and quantities of "non-routine" (exotic) radionuclides; and interviews with LANL personnel. Additionally, data capture work included targeted efforts to obtain and review occurrence and incident reports, all data pertaining to LANL's 10 C.F.R. 835 compliance and implementation, radiation work permits, survey data, and area and personal air monitoring data. Attachment One summarizes each of the Data Capture Requests issued as well as the materials captured from the site per those requests.

Though substantial quantities of data and documentation detailing the site's techniques and approaches to radiation exposure protection and monitoring have been captured and evaluated, NIOSH has not captured highly specific evidence documenting the site's radiation protection and monitoring program application to the postulated small, intermittent and short-term "bench-top" type of activities involving exotics. Not capturing this specific documentation (which by its supposed intermittent nature could exist in a very limited quantity) is not evidence that any radiation exposure assessment or protection failures have occurred.

Similarly, not capturing significant quantities of exotic radionuclide monitoring data are not an indicator that radiation protection failures have occurred. If work activity exposure potentials were determined to be below 100 mrem/year, no monitoring would have been required. Additionally, considering the limited work with exotics, sparse monitoring data availability for these radionuclides could be expected. As discussed in the introduction of this document, LANL did not collect bioassay samples in response to a specific job. LANL has stated that there was no routine bioassay monitoring program for exotic radionuclides [LANL 2021, PDF p. 5]. Special monitoring for exotic radionuclides would only be developed on a case-by-case basis as warranted by workplace radiological hazards [LANL, no date; LANL 2013a, PDF p. 13]. NIOSH has found no evidence that LANL's well-developed radiation protection program was enforced differentially for varying site work areas and/or activities.

A recurring discussion point from SC&A and the LANL Work Group during much of NIOSH's SEC-00109 evaluation effort has been that certain aspects of LANL's radiation protection program have been changed and/or evolved over time (later in the petitioned period) and that the

changes could be indicative of earlier deficiencies. This topic gained increased prominence after the identification of the LANL 1999 self-assessment that resulted in Noncompliance Report 484 [LANL 1999–2001]. In some instances, these changes were in response to recognized issues warranting improvement. These changes and improvements do not undercut the NIOSH conclusion that the weight of evidence derived from multiple evaluations of captured information indicates radiation doses for all LANL workers can be estimated with sufficient accuracy for the period from January 1, 1996, through December 31, 2005.

SC&A also cites LANL incident and observation reports as evidence of the continued use of exotic radionuclides during the 1996–2005 period and of potential exposures not assessed by a routine bioassay program [SC&A 2024, PDF pp. 83–84]. NIOSH reviewed the referenced reports and found that exotic exposure could have resulted. However, the captured and evaluated weight of evidence indicates that LANL took appropriate action to assess the exposure potential as well as control future exposure potentials. Note that LANL's internal monitoring requirement, based on 10 C.F.R. 835.402(c)(1), is for exposure potential under typical conditions. By their very nature, incidents are not representative of typical conditions. The cited incident reports do not indicate that LANL was inadequately monitoring exposures to exotics, but rather the opposite. None of the corrective actions identified in the cited observation reports involved establishing a routine bioassay program for exotics because the assessed internal exposure was nonexistent or a small fraction of the monitoring limit[6].

NIOSH has captured and presented evidence that LANL has:

- A comprehensive radiation protection program.
- A radiation protection program that covered operations involving exotic radionuclides.
- Performed assessments to ensure implementation of site procedures and 10 C.F.R. 835 monitoring requirements.
- Administrative and engineering controls to minimize radiation exposure potentials.
- Area and task-specific assessments/checklists.
- Executed commensurate responses to off-normal occurrences and incidents.

Details of the above attributes have been provided in NIOSH's *Addendum to Los Alamos National Laboratory (SEC-00109) Special Exposure Cohort Evaluation Report,* RPRT-0101, RPRT-0102, and RPRT-0103. While no individual radiation protection program attribute is dispositive, taken collectively, they provide a compelling weight of evidence that radiation doses for all LANL workers can be estimated with sufficient accuracy and that radiation doses from

[6] Of the observation reports cited by SC&A, one resulted in a measurable intake of an exotic radionuclide [Tc-99]. LANL's initial estimated dose was <1 mrem CEDE [LANL 1998b, pp. 18–19].

unmonitored exotic radionuclides would not be expected to be above 100 mrem/year during normal operations.

As LANL staff have stated on multiple occasions, and NIOSH has been unable to dispute, *typical* radiological conditions were such that personnel would not receive internal exposure to exotic radionuclides greater than 100 mrem/year. When off-normal conditions did occur, LANL personnel have stated (and NIOSH-captured evidence supports) that responses have been commensurate with the events. NIOSH has presented evidence that LANL controlled and assessed exposures to exotic radionuclides through administrative, engineering, and radiological oversight, along with the collection of special and prompt bioassay samples when warranted.

The weight of evidence indicates LANL was assessing exposure potential, monitoring when required, and controlling potential intakes of exotic radionuclides such that an internal dose of 100 mrem/year is bounding for unmonitored workers within the remaining 1996–2005 evaluated class. NIOSH concludes that LANL was monitoring workers with respect to the 10 C.F.R. Part 835 monitoring requirements. As such, NIOSH also concludes that 100 mrem/year CEDE represents a bounding dose for unmonitored workers.

SC&A Finding 8: Results in RPRT-102 are nontransferable to nonroutine, job-specific sampling for exotics

SC&A Finding 8

> *The results in RPRT-0102 for routine plutonium monitoring are not transferable to nonroutine, job-specific sampling for exotics, which was much more discretionary and based on individual line management or RCT judgments about job-related exposure potential.* [SC&A 2024, PDF p. 13]

NIOSH Finding 8 Analysis

In SC&A [2024], SC&A states:

> *Furthermore, the analysis in RPRT-0102 is designed around two assumptions* (NIOSH, 2022; slide 6):
>
> - *Bioassay programs for plutonium are specifically addressed because plutonium posed the greatest radiological hazard to workers at LANL during the study period (1996 to 2001)*
>
> - *If LANL was correctly monitoring for plutonium, what evidence makes us think the monitoring was different for other radionuclides of concern?* [PDF pp. 87–88]

NIOSH agrees with SC&A's Finding 8. NIOSH notes, however, that the text of RPRT-0102 does not state or imply that the report's results are "…transferable to nonroutine, job-specific sampling for exotics…". In discussions with the LANL Work Group, NIOSH made it clear that

RPRT-0102 is limited to plutonium. The quoted portion of the presentation was simply intended to question a potential assumption that LANL workers were leaving bioassay samples for routine radionuclides but not for exotics. Moreover, NIOSH has previously stated that a chronic co-exposure model for plutonium is not appropriate to bound potential short-term exposure to exotic radionuclides [NIOSH 2012b, pp. 9–12].

The discussion provided by NIOSH accompanying the above presentation [NIOSH 2022a] presented at a 2022 LANL Work Group meeting [NIOSH 2022b] was:

> *RPRT-0102 was developed to answer the question for plutonium. Why plutonium? I realize a conclusion was made that the primary radionuclides could not be used to address the exotics. Well, Report 0101 addresses the exotics, and I'm going to go through that a little bit later.*
>
> *Plutonium was used because plutonium posed the greatest radiological hazard to workers at LANL during the study period. If so if LANL was correctly monitoring for plutonium, what evidence would make us think that the monitoring was different for other radionuclides of concern? Also, what makes us think that a worker would leave the required bioassay sample for plutonium, but not for other radionuclides?*
>
> *So we've got all these workers and we've got -- we determined they come up, that they're leaving bioassay samples for plutonium. But what makes us think they're not doing it for other radionuclides? That's something to think about.* [PDF pp. 18–19]

As detailed above, NIOSH has previously acknowledged that RPRT-0102 focuses on plutonium monitoring at LANL and that a chronic co-exposure model is not appropriate to bound potential short-term exposure to exotic radionuclides [NIOSH 2012b, pp. 9–12]. The only NIOSH implied connection between plutonium and exotics monitoring was to question, as a very general, potential weight-of-evidence discussion topic during a Work Group meeting, why plutonium monitoring requirements would be conducted appropriately but monitoring for exotics would not.

CONCLUSION

NIOSH concludes that the weight of evidence derived from multiple evaluations of captured information indicates that radiation doses for all LANL workers can be estimated with sufficient accuracy. No evidence to the contrary has been found or presented. Additionally, NIOSH has found no evidence that LANL's well-developed radiation protection program was enforced differentially at varying site work areas or work activities as was originally questioned and used as the basis for the 1976–1995 SEC class addition.

As summarized in the NIOSH Finding 7 Analysis (see bullets on page 23 above), multiple types of evidence have been collected supporting the conclusion that LANL was assessing and controlling intakes of exotic radionuclides such that an internal dose of 100 mrem CEDE/year is

bounding for unmonitored workers within the remaining January 1, 1996, through December 31, 2005, evaluated class.

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Note: All page numbers specified in the reference callouts correspond to PDF page numbers assigned within NIOSH's Site Research Database (SRDB), not those identified in the publicly available version of the referenced document. All documents residing within the SRDB contain at least one administrative page attached to the beginning of each document. As a result, page number callouts identified in this paper (accessed through the SRDB) will not correspond precisely with the page numbers for the same referenced document when accessed through the NIOSH website.

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Attachment One: LANL Data Capture Request Summary

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY23-008 06/14/2023	All available formal documentation of a "cool down" period, whether enforced or otherwise, after a shutdown of the accelerator beam at LANSCE prior to re-entry of personnel during the years 1996–2005 [ORAUT 2012–2024, pp. 177–179]	07/20/2023	One associated email and five procedures from the LANSCE Accelerator Operations manual: • Chapter 3 Safety and Operations Envelopes • Chapter 6 IPF Tunnel Sweep and Entry Procedures • Chapter 6 PSR Sweep and Entry Procedures • Chapter 6 Target Area Sweep and Entry Procedures • Chapter 6 PSR Sweep and Entry Procedures [SRDB ID: 197819]
FY23-007 02/27/2023	A conference call with the appropriate TA-53 LANL staff to discuss specific questions and others that may arise during the conference call [ORAUT 2012–2024, pp. 174–176]	03/09/2023	A MS Teams meeting was scheduled for 03/14/2023 [SRDB ID: 196444]
FY23-006 02/28/2023	LANL staff identify all holdings that contain RWPs used by the Radiation Protection group in TA-53 for the period from 1996 to 2005 Provide site access and LANL staff support as necessary to review and scan TA-53 RWP holdings, as related to Item 1 Provide a second tour of the TA-53 accelerator line for team members who were not available for the previous tour. Conduct a conference call with the appropriate TA-53 LANL staff to discuss specific questions regarding radiological sources [ORAUT 2012–2024, pp. 169–173]	03/13/2023	Letter that included a table of RWP holdings [SRDB ID: 196443] Notes from data capture and TA-53 tour [SRDB ID: 196585, 206929] A Microsoft Teams meeting was scheduled for 03/14/2023 [SRDB ID: 196444]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY23-005 02/13/2023	All versions, including drafts for January 1, 1995, to Present, of the following: • CSP-367 - Preparation of Urine Samples for Uranium Bioassay • CSP-374 – Sample Preparation for Plutonium in Urine by TIMS • BSP-374 - Sample Preparation for Plutonium in Urine (replaced by CSP-374) • Preparation for Plutonium in Urine by RAS • Preparation for Americium in Urine by RAS and ICPMS • Preparation for Tritium in Urine Any sample preparation documents available during periods LANL may have outsourced their urinalysis for uranium, plutonium, americium, and tritium Any documents that involved or discussed the normalization of bioassay sample results by the Radiation Protection – Internal Dosimetry Group (RP-SVS) Revision 1 of "Radiation Protection," Procedure P-121 Revision 4 of "Integrated Work Management," Procedure P300 All revisions of "Operation and Maintenance of the Gate Radiation Monitor," ESH-1/TA-53-DP-304 All revisions of "Routine Monitoring Instructions," HSR-1/TA-53 (for period 1996 through 2005) [ORAUT 2012–2024, pp. 166–168]	03/21/2023	LANL response letter addressing document needs [SRDB ID: 196446] 98 additional files were uploaded into the SRDB [SRDB ID: 207144]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY23-004 12/12/2022	Email question related to aliquot size for bioassay samples [ORAUT 2012–2024, pp. 163–165]	12/21/2022	Response email with question answered [SRDB Ref ID: 207142]
FY23-003 12/08/2022	Resolve questions based on the attached HPAL Submittal and HPAL Analysis Report forms (Attachment A) [ORAUT 2012–2024, pp. 158–162]	02/28/2023 04/12/2023	A formal response from LANL was not identified during preparation of this document. Notes from TA-53 tour briefly address the questions specified in the data request [SRDB ID: 196585, 206929]
FY23-002 11/15/2022	Access to boxes for records listed in Table 1 and 2 of the data request letter A technically based tour of the TA-53 accelerator line during the site visit [ORAUT 2012–2024, pp. 150–157]	11/29/2022	Response letter indicating how the site will assist with records and point of contact for TA-53 tour [SRDB ID: 194701]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY23-001 10/20/2022	"Los Alamos National Laboratory 10 C.F.R. 835 Radiation Protection Program (RPP)," Revision 3, LM107-03, October 20, 1999 LANL Notice: "Implementation of Amended 10 C.F.R. 835 Rule, Occupational Radiation Protection," issued by ESH-1 to LANL on February 24, 2000 Independent assessment of LANL bioassay program, conducted by Duke Engineering, Sept 24-25, 1998 (Seq #7, p. 4 of NC ID 715) Internal LANL assessment of bioassay program, conducted Mar 11-12, 1998 (Seq #10, p. 6 of NC ID 715) [ORAUT 2012–2024, pp. 147–149]	11/16/2022	LANL provided the following documents: • LANL Supplemental Response to Data Request LANL FY23-001 Data Need 1 LANL 10 C.F.R. 835 Radiation Protection Program [SRDB ID: 195558] • Data Request LANL FY23-001 NCTS Reports and Reports Pertaining to LANL's Implementation of 10 C.F.R. Part 835 [SRDB ID: 195559] • Los Alamos National Laboratory 10 C.F.R. 835 Radiation Protection Program Document Evidence (Matrix) 1999 [SRDB ID: 195560] • LANL Supplemental Response to Data Request LANL FY23-001 Occupational Radiation Protection and Bioassay Program Assessment [SRDB ID: 195579] • Implementation of Amended 10 C.F.R. 835 Rule, Occupational Radiation Protection LANL 2000 [SRDB ID: 195581] • Laboratory Implementation Requirements LANL 1998 [SRDB ID: 195582] • Laboratory Implementation Requirement Occupational Radiation Protection Requirements LANL 2002 [SRDB ID: 195583] • Los Alamos National Laboratory 10 C.F.R. 835 Radiation Protection Program With Document Evidence (Matrix) 2001 [SRDB ID: 195584]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY22-006 08/15/2022	Answers to questions in regard to LANSCE Health Physics: • How were the radionuclides Na-22, Mn-54, Eu-152, Be-7, and C-11, which were typically provided for LANSCE in vivo count results chosen? • Why was Co-60 not reported in previously provided in vivo count results? Can Co-60 results (or the MDA for Co-60) be obtained for the in-vivo bioassay performed 1996 through 2005? The following items: • Electronic database/spreadsheet of LANSCE stack monitoring data for 1996 through 2005 • Workplace air monitoring data, if available for the period 1996 through 2005 period • Finding aid that identifies where hard copy records of measurements of LANSCE accelerator cooling water in the 1996 through 2005 period are maintained, which will be used to identify additional documentation to be reviewed and collected [ORAUT 2012–2024, pp. 144–146]	09/20/2022	LANL provided the following documents: • LANL Release Letter for Documents Captured September 22, 2022 [SRDB ID: 193708] • LANL Response to Data Request LANL FY22-006 Seeking Accelerator-Associated Documentation for 1996-2005 [SRDB ID: 194352] • In Vivo Bioassay Measurements Technical Basis Document LANL 2010 [SRDB ID: 194353] • The LANL Germanium Lung and Whole Body In Vivo Measurement System 1999 [SRDB ID: 194354] • LANSCE Stack Release Date LANL 1996-2005 Spreadsheet [SRDB ID: 194355] • LANSCE Login Data for Samples Submitted to the HP Analytical Laboratory (HPAL) for LANSCE (TA-53) LANL 1996-2007 Spreadsheet [SRDB ID: 194356] • Search Results for Key Words LAMPF, Air Monitor, Giraffe, RMI, Respiratory, Fixed Air and TA-53 LANL 1963-2013 Spreadsheet [SRDB ID: 194357] • Finding Aid for Samples and Reports LANL 1995-2008 [SRDB ID: 194358] • Finding Aid for Key Words LAMPF, Air Monitor, Giraffe, RMI, Respiratory, Fixed Air and TA-53 LANL 1995-2008 [SRDB ID: 194359]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY22-005 06/30/2022	1. LANL identify a current or former Health Physicist or other knowledgeable employee(s) within the Health Physics organization with accelerator experience to participate in an interview. The interviewee(s) should have extensive knowledge of Health Physics practices and records associated with accelerator operations. The period of interest for this activity is January 1, 1996 – December 31, 2005. Topics include: • Routine measurements made by LANSCE Health Physics group of activated TA-53 target corrosion products in target coolant water • Air concentration results for TA-53 to include continuous and spot samples results • Air concentration results for TA-53 stack emissions 2. Copies of, or access to inventory calculations for the copper beam stop and any stainless steel that is activated by neutrons for 1996 through 2005 [ORAUT 2012–2024, pp. 141–143]	07/11/2022 07/13/2022	Letter providing points of contact for interviews [SRDB ID: 193215] Email with Area A East Radionuclide Inventory (11/20/2007 and 4/8/2022) calculation [SRDB ID: 193216]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY22-004 05/25/2022	To determine the presence, identification, and quantities of "exotic" radionuclides that resulted from accelerator operations, request that LANL identify current or former Accelerator Physicist(s) or knowledgeable employees to participate in interviews. The period of interest for this activity is January 1, 1996 – December 31, 2005. Questions include: • Are calculations of radionuclide yields for typical combinations of target composition, beam energies, and beam currents available? • What records were maintained for accelerator operations? [ORAUT 2012–2024, pp. 138–140]	06/06/2022	Mark 2 1L Target Radionuclide Inventory Recalculated [SRDB ID: 196432] Mark 2 1L Target Radionuclide Inventory Recalculated From July 5, 2002, to December 23, 2005 [SRDB ID: 196433] ID accelerator physicists or employees with knowledge of LANL Accelerator Operations and Technical Aspects [SRDB ID: 197362]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY22-003 03/09/2022	1. What documented criteria do you currently use (e.g., yesterday) to decide if a given worker was likely, under typical conditions, to exceed 100 mrem CED and therefore placed in the bioassay program? 2. What documented criteria was used during the period January 1, 2000, through December 31, 2000 to decide if a given worker was likely under typical conditions to exceed 100 mrem CED and therefore would have been placed in the bioassay program? 3. Provide written affirmation for why "in process" radiological surveys are not always available or linked to the applicable RWPs (as verbally stated during the call). [ORAUT 2012–2024, pp. 135–137]	04/05/2022	Response letter noting that Need #1 was similar to questions asked under FY13-001. LANL provided the response to FY13-001 in addition to the following documents [SRDB ID: 192418]: • TIP-007. Algorithm for Monitoring • TIP-018. Bioassay Program Enrollment Criteria • TIP-027. Bioassay Monitoring for Thorium • Internal Dosimetry Technical Basis Document Internal Dosimetry Technical Basis Document • RP-1-DP-05, Rev 4. Radiological Activity Reviews • RP-1 Form 11.03. New Activity ALARA Review • Acceptance Criteria For In-Vitro Bioassay Data • RP-2-ASA-01, R02. C-NR, and RP-2 Analytical Service Agreement • RP2-ID-DP-03. IVBS, R2. Bioassay Data Review • Dosimetry Requirement by work activity and facility • Requested affirmation provided in LANL response letter

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY22-002 01/18/2022	1. Requests information concerning the availability and technical content (e.g., personnel transaction logs/records, calibration records, response checks, etc.) of portal monitor records in electronic format for the period 1996 through 2005 for TA-3, TA-48, and TA-53 2. Requests information concerning the availability of air monitoring and smear contamination records in electronic format for the period 1996 through 2005 for TA-3, TA-48, and TA-53 3. Requests information concerning the availability of records, which provide radiological isotope source term information at the linear accelerator/spallation site in TA-53 4. Requests copies of, or access to, all RWPs written for work in TA-3, TA-48, and TA-53 (excluding plutonium or americium related work) for the period 1996 through 2005 [ORAUT 2012–2024, pp. 132–134]	02/01/2019	Response letter addressing all data needs • LANL indicates that the best records associated with Needs #3 and #4 were previously requested 19-002 and 19-004, respectively • Provides safety basis calculation for LANCE [SRDB ID: 192061]
FY22-001 11/23/2021	1. From January 1, 1996, through December 31, 2005, did LANL have a bioassay procedure for Tc-99? If not, how was a potential internal intake of Tc-99 addressed? 2. Please provide the technical documentation that governs how Tc-99 potential intakes were addressed [ORAUT 2012–2024, pp. 129–131]	12/01/2021	Response letter addressing both data needs • Tc-99 was not a routinely monitored radionuclide • Provides internal dosimetry technical basis document [no date] in response to Need #2 [SRDB ID: 191395]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY21-004 03/29/2021	Request dosimetry threshold values used from January 1, 1996, through December 31, 2005, for the following isotopes: • Ac-227 • Cm-244 • Np-237 • Pa-231 • Sr-90 [ORAUT 2012–2024, pp. 123–125]	04/12/2021	Response letter indicating no thresholds provided because these radionuclides were not routinely measured [SRDB ID: 186038]
FY21-003 03/12/2021	Request Portal Monitor or Portal Contamination Monitor (PCM) procedures from January 1, 1995, through December 31, 2005 [ORAUT 2012–2024, pp. 120–122]	04/012021	Response letter including the following attachments [SRDB ID: 185816]: • Table 1. Personnel Contamination Monitors (PCMs) and Portal Monitors at LANL • Table 2. Hand and Foot Monitors (HFMs) at LANL • Table 3. LANL Inventory of Fixed Instruments for Contamination Monitoring • Table 4. LANL Inventory of Major Portable Instruments • Attachment A. LM107-01.1 LANL Radiological Control Manual, Articles 221, 338, 346, 347
FY21-002 02/04/2021	Specific in vitro bioassay related clarifying question: What does "BC" stand for? Note: This request was not submitted in the traditional format, but rather an email exchange asking the question. [ORAUT 2012–2024, pp. 114–119]	02/05/2021	Response email (included in the data request compilation document) [SRDB ID: 207145, PDF p. 115]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY21-001 10/15/2020	1. The ORAU Team noted that a there are multiple entries on the same RWP Acknowledgment sheet by the same person. The understanding we have is that the RWP Acknowledgment was not used as an access control mechanism and that there should be a single entry per person for each RWP Acknowledgment sheet. • Please confirm the purpose of the RWP Acknowledgment sheet, was it just a tool to confirm individuals understand the conditions and requirements or did it have a more expansive function? • Should an individual have only signed the RWP Acknowledgment sheet once or would it be normal for the same person to sign the same RWP Acknowledgment sheet in some cases multiple times during the same day? 2. Previous discussions with site personnel indicated a significant amount of work on-site was conducted without a RWP, if this understanding is correct the ORAU Team would like to understand. • What processes or procedures were employed for non-RWP work? • Did only RWP work require bioassays be performed or would non-RWP work in some cases also have required bioassay sampling? 3. Requests copies (all revisions) of RWPs related procedures or guidance that would have been used during the period of January 1, 1996, through December 31, 2002 4. The RWP has an entry position for "Organization Code," we do not need to know what each code stands for but would like to understand how to compartmentalize the various codes [ORAUT 2012–2024, pp. 109–113]	11/10/2020	Response letter addressing Needs #1 and #2, with additional attachments included in the response addressing Needs #3 and #4: • Attachment A) LM107-01.1 LANL Radiological Control Manual, Articles 321, 322, 323, 324 • Attachment B) RPP107-20 Work Planning • Attachment C) LIR402-720-01.1 Work Planning • Attachment D) LPR-402-720.0 Work Planning • Attachment E) LIR402-700-01.1 Occupational Radiation Protection • Requirements, Section 1.1 Background • Attachment F) Table of Identified Organization Names from RWP Pre-Job Briefing Acknowledgment Logs [SRDB ID: 184012]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY20-002 04/09/2020	Assess past employee participation in LANL bioassay programs by requesting a copy of data within the Bioassay Enrollment Scheduling and Tracking (BEST) system or other database (as appropriate), that includes records for all monitored personnel, for the period of January 1, 1996, through December 31, 2002 Requests answers and supporting documentation such as implementing procedures and implementation evidentiary files, to each question listed. The goal of these questions is to assist the ORAU Team to better understand how the LANL bioassay program was implemented during the period of January 1, 1996, through December 31, 2002. • It is our understanding that the Pu access list was a mechanism to ensure compliance with the Pu bioassay program. Were there similar lists used to ensure compliance with bioassay programs for other radionuclides? • If there were similar lists, please describe them and provide examples of each. • Does the BEST system include in vivo monitoring data, e.g., data from DATATREVE /OMNIS-7? If not, is there another database similar to BEST that contains this information? • If there is a different data base for in vivo, please describe it and provide an example printout from the database. • What processes/procedures were in place to ensure and verify worker compliance with the in vivo program? • What mechanism was in place to limit access to workers who were not in compliance with the in vivo monitoring program? [ORAUT 2012–2024, pp. 105–108]	03/15/2021	Response letter addressing all data needs [SRDB ID: 185577]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY20-001 10/03/2019	Requests access (for review) to all Records Transfer Reports that may contain Health Physics Checklists, and work permits such as RWPs or SRWPs for the period of January 1, 1996, through December 31, 2001, for all areas of LANL [ORAUT 2012–2024, pp. 102–104]	See next column	In response to this data request and through coordination with LANL, ORAUT performed the following data capture trips to LANL and the Dayton Federal Records Center: 10/14-18/2019 – Performed a site visit, which is a continuation of the effort to identify and collect RWPs used during the period of 1996–2001 throughout the site. This will ultimately support an effort to compare RWP entrants requiring bioassay analysis with actual documented bioassays. The visit resulted in the review of 78 boxes and collection of 180 documents consisting of 24,295 pages. Most notably, this onsite effort identified 1,721 "Notable" RWPs, which are defined as falling within the period of interest and having entrants who required bioassay analysis. 11/04-08/2019 – Performed a site visit as a continuation of the effort to identify and collect Radiation Work Permits (RWP) used during the period 1996–2001 throughout the site. This week's effort included the review of 68 boxes resulting in the collection of 141 documents consisting of 33,796 pages. The collected documents are primarily "notable" RWPs (i.e., those within the timeframe that required bioassay and have attached acknowledgment sheets) and a substantial number of Radiation Incident Reports (RIR) from 1996, 1997 and 1998. Additionally, some missing Health Physics checklists were located and captured. 12/02/2019 – Performed a site visit to the Dayton Federal Records Center which resulted in the capture of 19 documents consisting of 9,527 pages. RWPs: [SRDB IDs: 178672–178674, 178854–178865, 181033–181117, 181146, 181224, 183591–183617, 183619, 183622–183629, 183631–183684]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
			Incident Reports: [SRDB IDs: 181225, 181227–181229, 183617, 183618, 183620, 183630] Bioassay Prog. Rep.: [SRDB ID: 179013, PDF p. 41] Employee List: [SRDB ID: 178851] TLD Ring Exp: [SRDB ID: 178852] Stack Sampling (TA-3): [SRDB ID: 178853] Air Sampling: [SRDB IDs: 180956–180959, 183621] Nasal Swipe Logs: [SRDB ID: 180960] Direct & Smear Surveys (TA-3): [SRDB IDs: 180957, 183590] HP Checklists: [SRDB IDs: 178563–178576]
FY19-005 08/02/2019	1. Requests a box list of all holdings containing HP Checklists, site-wide work permits such as RWPs used to control access to and activities within Radiologically Controlled Areas. The period of interest for RWP is January 1, 1996, through December 31, 2001, and the period of interest for HP Checklists is January 1, 1985, through December 31, 2001, for all areas of LANL 2. Requests access to all holdings identified in Item #1	See next column	In response to this data request and through coordination with LANL, ORAUT performed the following data capture trips to LANL and the Dayton Federal Records Center: 08/19-23/2019 – Performed a site visit at the Denver Federal Records Center resulting in the review of 60 boxes and the collection of 49 documents (Radiation Work Permits & HP checklists) consisting of 11,070 pages. This was the initial effort to review documentation responsive to Data Request LANL-FY19-005 Rev 01, which requested access to holdings

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
	above that contain the responsive HP Checklists (hard or electronic versions), along with LANL site staff support as necessary for the ORAU Team to access, conduct a holdings inventory and digitize relevant documentation as necessary 3. Requests access to all holdings identified in Item #2 above that contain the site-wide RWPs, along with LANL site staff support as necessary for the ORAU Team to access, conduct a holdings inventory and digitize relevant documentation as necessary 4. Requests LANL site staff support as necessary (e.g., escort) as the ORAU Team implements a statistical sampling plan, which requires a detailed review of the holdings inventoried in Item #2 and #3 to identify the affected worker population (by name) [ORAUT 2012–2024, pp. 98–101]		containing Health Physics checklists, Radiological Work Permits, and personnel exposure data for the period of January 1, 1996, through December 31, 2001. 09/23-27/2019 – Performed a site visit at the Denver Federal Records Center in support of the LANL RWP/bioassay effort. The ORAU Team reviewed 170 boxes and collected 39 documents comprised of 10,336 pages. The material collected includes radiological incident reports, site procedures, and some personnel dosimetric information. The primary targeted material of RWPs with bioassay required within the period of 1996–2001 was very limited. Many RWPs were located but they were not "Notable" (i.e., required bioassay and within the timeframe of interest). In the final reconciliation of the request versus material provided for review, seven of the accessions were not provided for review. Five of the accessions consisting of approximately 11 boxes would be made available at the LANL site for review. HP Checklists: [SRDB IDs: 178067, 178070, 178073, 178075, 178077–178081, 178083–178092, 178094–178099, 178104] RWPs: [SRDB IDs: 178068, 178071, 178072, 178074, 178076, 178082, 178093, 178100, 178102, 178105, 178112, 178113–178129, 178131–178251, 178260, 178281, 178282, 178285, 178286, 178421] Employee List: [SRDB ID: 178101] Smears: [SRDB ID: 178130]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
			Incident Reports: SRDB IDs: 178420, 178423–178429, 178431, 178435–178437, 178439–178447, 178453] Dosimetry: [SRDB ID: 178422, 178448–178451]
FY19-004 07/10/2019	Superseded by FY-19-005 [ORAUT 2012–2024, pp. 94–97]	NA	NA
FY19-003 04/26/2019	Requests site staff support as necessary to access the 214 boxes listed on Attachment A, "Boxes Responsive to Data Request LANL-FY19-002" for the purpose of reviewing and digitizing relevant material Requests site staff support as necessary to access five classified boxes, from Accession A-1997-045 Requests site assistance in arranging interviews with two current workers knowledgeable of the Radiological Control Department (names will be provided by phone) [ORAUT 2012–2024, pp. 88–93]	See next column	05/20-23/2019 – Conducted a site visit to the Los Alamos National Laboratory (LANL) responsive to Data Request LANL-FY19-002 (requested air and contamination data for 1996-2005) and in support of SEC-00188 • A total of 88 boxes were reviewed and 128 documents were scanned consisting of 17,457 pages 06/10-13/2019 – Conducted a site visit to the Los Alamos National Laboratory requested in LANL-FY19-003, to review boxes responsive to Data Request LANL-FY19-002 • This is a continuation effort addressing the review of 231 total boxes • Resulted in the review of 108 boxes and 145 documents being captured consisting of 24,064 pages 07/15-18/2019 – Conducted a site visit to Los Alamos National Laboratory • Resulted in the review of 31 boxes and collection of 162 documents consisting of 20,474 pages • The material primarily contains radiological survey and

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
			airborne sampling data • This completed the current data capture activity [SRDB ID: 207143]
FY19-002 04/01/2019	Requests access to, or copies of, air monitoring and contamination survey data for Chemistry and Metallurgy Research facility for CY 1996, 1997, 1998, 1999, 2002, 2003, 2004 and 2005 Requests access to, or copies of, all air monitoring and contamination survey data from January 1, 1996, through December 31, 2005, for LANSCE Requests access to, or copies of, all air monitoring and contamination survey data from January 1, 1996, through December 31, 2005, for the Radiochemistry Site at TA-48 Requests access to, or copies of, LANSCE procedures used to control worker access to airborne contamination areas from January 1, 1996, through December 31, 2005 [ORAUT 2012–2024, pp. 85–87]	04/24/2019	LANL identified 214 boxes. Items captured under FY19-003 are related to boxes LANL identified. The listings provided by LANL are not reproduced in this document.
FY19-001 01/08/2019	Requests an electronic version in either database or spreadsheet format that contains site-wide radioactive material inventories for all years that such data are available, ideally including specific radionuclides, their quantities, locations, and physical forms [ORAUT 2012–2024, pp. 82–84]	02/11/2019	NESHP data related to air effluents from LANL facilities [SRDB ID: 175428]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY17-001 08/02/2017	Requests either copies, or the location of, any documentation associated with the following Price-Anderson Noncompliance Tracking System (NTS) reports: NTS-ALO-LA-LANL-LANL-1999-0004 (Internal Dose Evaluation Program - Independent assessment of the LANL Internal Dose Evaluation program identified deficiencies) and NTS-ALO-LA-LANL-LANL-2002-0014 (Personnel Dosimeter Assignment - On-line dosimetry assignment report providing incorrect information) Examples of desired documentation include: • Initiating event documentation such as Occurrence Reporting Processing System (ORPS) or other incident reports • Notice of Violation, if applicable • Evidentiary files related to the completion and closure of associated corrective actions [ORAUT 2012–2024, pp. 79–81]	See next column	09/12-13/2017 – Performed a site visit at the DOE Legacy Management – Westminster Office and reviewed two boxes and captured 22 documents (3,963 pages) related to various Price-Anderson Noncompliance Tracking System reports. 10/13/2017 – Received and announced two prioritized files from the September 12-13, 2017 site visit to DOE Legacy Management Office in Westminster, Colorado which included originating and evidentiary information related to Price-Anderson noncompliance tracking reports NTS-ALO-LA-LANL-LANL-1999-0004 and NTS-ALO-LA-LANL-LANL-2002-0014 12/13/2017 – Posted and announced 22 Price-Anderson Noncompliance Tracking System reports received from Los Alamos National Laboratory (LANL). These reports were obtained during a September 2017 site visit to the DOE Legacy Management Westminster Office and reviewed for classification and released to the ORAU Team [SRDB IDs: 168052, 168053, 168446-168467]
FY15-007 10/06/2015	Requests a copy of a LANL Report LA-10947-MS, May 1987 on intrinsic radiation [ORAUT 2012–2024, pp. 76–78]	12/10/2015	Response letter indicating the requested document is classified and not available in the SRDB [SRDB ID: 150382]
FY15-006 08/24/2015	Requests access to the LANL site and the boxes listed on Attachment A, "List of LANL Boxes Requested for Review" for the purpose of review and collection, as applicable, of relevant material. [ORAUT 2012–2024, pp. 72–75]	02/25/2016	Documents included radiation work permits, work instructions, radiological surveys, airborne sample data, and personnel exposure data, including: • UCNI - RWPs 2001 [SRDB ID: 151805] • UCNI - RWPs TA-55 1997 [SRDB ID: 151906] • CST-25 Implementing Source Control Requirements

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
			[SRDB ID: 151907] • Source Control Compliance With 10 C.F.R. 835 [SRDB ID: 151908] • UCNI - Samples of RWPs TA-55 2003 [SRDB ID: 151909] • UCNI - RWPs TA-55 2001 [SRDB ID: 151910] • Samples of Radiation Monitoring Instruction Checklist TA-55 and PF-4 1999 [SRDB ID: 151911] • UCNI - RWPs TA-55 2000 [SRDB ID: 151912] • Radiation and Contamination Surveys at TA-18 1997 [SRDB ID: 151913] • Annual X-Ray Protection Surveys 1997 [SRDB ID: 151915] • Radiological Incident Reports TA-18 May - November 1997 [SRDB ID: 151916] • RWPs TA-18 November 1996-1997 Mention of NP-237, U-235, and Fission Products [SRDB ID: 151917] • Air Sample Analysis TA-18 December 1996–1997 [SRDB ID: 151918] • External Dosimetry Badge System, Positive Personnel Monitoring Exposure Reports NIS-6 January– May 1997 [SRDB ID: 151920] • RWPs TA-55, TA-35 and PF-4 October 1996–November 1997 [SRDB ID: 151921] • UCNI - Samples of Radiological Surveys TA-55, PF-4, and Various Rooms 2001 [SRDB ID: 151922] • UCNI - Samples of Radiological Contamination Surveys TA-55, PF-4, and Various Rooms 2002 [SRDB ID: 151923] • UCNI - RWPs TA-55, PF-4, and Various Rooms 1997-1998 [SRDB ID: 151924] • UCNI - RWPs TA-55, PF-4, and Various Rooms 2001

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
			[SRDB ID: 151925] • UCNI - Samples of Radiological Surveys TA-55, PF-3, and Various Rooms 2002 [SRDB ID: 151927]
FY15-005 6/24/2015	1. Requests clarification of the following issue: Issue: It was noted that Attachment A has 31 items listed, however, page 2 of Attachment B indicates there are 29 items 2. Requests the location of, and access to documentation related to the receipt, control, monitoring, and personnel protection associated with each item, which is not a sealed source listed on Attachment A. The requested supporting information should include the following items: • Initial receipt documentation and radiological surveys • Isotopic profile and quantity • Radiation or special work permits • Associated area radiation surveys • Associated area or personnel air sample results • Documentation of technical evaluations made regarding the determination to require or not require internal monitoring (i.e., bioassay) and supporting personnel monitoring data if such monitoring was required [ORAUT 2012–2024, pp. 64–71]	07/20/2015	1. Response letter addressing Need #1 2. Provided similar information as provided in response to FY15-001 – The response laid out an approach to identifying the records Note: Included here is a listing of records that were investigated under the activities of FY15-006 that can be associated with Need #2 [SRDB ID: 207146]
FY15-004 03/20/2015	Requests bioassay records for six LANL workers [ORAUT 2012–2024, pp. 61–63]	04/07/2015	LANL provided records for all six workers [SRDB IDs: 143847, 143848, 143849, 143850, 143851, 143852]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY15-002 12/01/2014	Requests documentation related to the receipt, control, monitoring, and personnel protection associated with each item listed on Attachment A. The supporting information should include the following items: • Initial receipt documentation and radiological surveys • Isotopic profile and quantity • Radiation or special work permits • Associated area radiation surveys • Associated area or personnel air sample results • Documentation of technical evaluations made regarding the determination to require or not require internal monitoring (i.e., bioassay) Requests documentation associated with the radiation protection aspects of work related to NP-237 cutting and encapsulation as identified on Attachment B "NP-237 Cutting and Encapsulation Memorandum." The supporting information should include the following items at a minimum: • Radiation or special work permits • Associated area radiation surveys • Associated area or personnel air sample results • Associated documentation of technical evaluations made regarding the determinations to require or not require internal monitoring (i.e., bioassay) [ORAUT 2012–2024, pp. 54–60]	03/18/2015	Response letter with attachments: • Sealed source information from LANL database • RP-SVS-ID-TBD-01.DATS, R4. Internal dosimetry technical basis document (1/29/2015) [SRDB ID: 144168]

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY15-001 10/13/2014	Per the October 9, 2014, conference call between LANL staff, NIOSH, and DOE, the ORAU Team requests information related to examples of non-routine radionuclides which are of at least accountable levels having been received by LANL between January 1, 1996, and December 31, 2005 (preferably closer to 1996 if possible) Specific information request includes: • Receipts or shipments of non-routine (i.e., "exotic" radionuclides, which for this purpose is defined as any radionuclide other than tritium, americium-241, or isotopes of plutonium or uranium) • Quantities of radioisotopes received • Dates of receipt • Locations material went to (e.g., technical areas, buildings, etc.) • Names of individuals/programs involved with use of the radionuclide [ORAUT 2012–2024, pp. 51–53]	11/06/2014	The response consisted of a single-page list that included entries for Am-243, Cf-252, and Np-237 [SRDB ID: 144168, PDF p. 7] A follow-up data request (FY15-002) was submitted, which included follow-up questions related to the information provided in response to this request. Note, the LANL response to this request is included as Attachment A of request FY15-002

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY14-007 04/23/2014	Per the phone conference between LANL staff, NIOSH and DOE of April 7th, the ORAU Team requests all data from the 1990s pertaining to 10 C.F.R. 835 compliance for LANL Particularly interested in exotic radionuclides (those excluding plutonium, gaseous-liquid tritium, cesium and americium) The requested information should include: • All field data • Dosimetry back up data • Theoretical and field data-based calculations • Reference documentation that supports compliance [ORAUT 2012–2024, pp. 48–50]	07/02/2014	Letter response providing documentation from 1994 and 1995 regarding the compliance position for 10 C.F.R. 835 article 402(C)(1). Includes the following attachments: • LS107-11.0. Radiation Dosimetry Monitoring (12/23/1994) • Articles 521-523 from LM107-01.01. LANL Radiological Control Manual (12/23/1994) [SRDB ID: 133601]
FY14-003 01/03/2014	Superseded by FY14-007 [ORAUT 2012–2024, pp. 34–47]	NA	NA
FY14-002 12/18/2013	Superseded by FY14-007 [ORAUT 2012–2024, pp. 26–34]	NA	NA

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
FY14-001 12/03/2013	Requests the following for each question contained in Attachment A, "Questions for LANL Staff Regarding Internal Dosimetry Program": • Answer to each question • Supporting documentation/records related to each response • Reference material cited in any provided documentation if the reference is relevant to the question response [ORAUT 2012–2024, pp. 21–25]	N/A	A formal response from LANL was not identified during preparation of this document. The following documents appear to be in response to the request: • ESH-4 in vivo measurements laboratory quality assurance program plan [SRDB ID: 107382] • Various in Vivo operating procedures [SRDB ID: 107682] • In vitro lung counter procedures [SRDB ID: 110379] • TA-53 Stack Samples [SRDB ID: 107408]
FY13-003 06/13/2013	Requests the following items be provided in response to the follow-up questions contained in Attachment A, "NIOSH Follow-up Questions for LANL Staff Regarding 10 C.F.R. 835 Implementation and Unresolved Issues": • Answer to each question • Supporting documentation/records related to each response • Reference material cited in any provided documentation if the reference is relevant to the question response [ORAUT 2012–2024, pp. 14–20]	09/12/2013	Letter response to each question and the following attachments: • Technical Issue Paper 018, Bioassay Program Enrollment Criteria • RP-1 Form 01, Approvals-RP-1 Group Procedures • RP-1-DP-05 Rev. 4, Radiological Activity Reviews • Acceptance Criteria for In-Vitro Bioassay Data • RP-2-ASA-01 Rev 02, C-NR and RP-2 Analytical Service Agreement • RP2-ID-DP-03.IVBS Rev 2, Bioassay Data Review [SRDB ID: 127655]
FY13-001 12/04/2012	Answers and supporting documentation to the seven sections of questions contained in Attachment A, "NIOSH Questions for LANL Staff Regarding 10 C.F.R. 835 Implementation and Unresolved Issues" The seven sections included: • Section 1 - Exotic Alpha-emitters • Section 2 - Fission Products	03/19/2013 04/22/2013	Letter response with the caveat that the information provided was to the best of their ability based on limited funding and didn't perform an extensive investigation into the data available within the LANL internal dosimetry records system [SRDB ID: 166130] Additional 12 documents used as reference within a site response to a 10 C.F.R. 835.402 questionnaire communicated

Data Request ID and Date	Data Requested	Data Received Date	Data Received Summary and Associated SRDB IDs
	• Section 3 - Activation Products • Section 4 – Thorium • Section 5 - Special Tritium Compounds (STCs) • Section 6 - Unresolved Petitioner-Raised Questions/Issues • Section 7 - Unresolved NIOSH Issue Regarding Current In Vivo Counting Practices [ORAUT 2012–2024, PDF pp. 2–13]		in Data Request LANL-FY13-001 were provided: • P121, Radiation protection [SRDB ID: 126275] • ANSI/HPS N13.29-2001 [SRDB ID: 126273] • New Activity ALARA Review (NAAR Feb 2007) [SRDB ID: 126279] • Radiological Work Control Process (RWCP, Dec 2006) [SRDB ID: 126278] • DOELAP Certificate with Conditions of DOELAP Accreditation for LANL Radiobioassay Program (Current: 12/5/2012) [SRDB ID: 126271] • LAL In vivo bioassay Measurements Technical Basis document (RP2-ID-TBD-01.IVML, R2, Interim Change 7/1/2012) [SRDB ID: 126281] • LANL Internal Dosimetry Technical basis Document (RP2-ID-TBD-01.DATS, R2, 10/01/2010) [SRDB ID: 126280] • LANL, RP-2 Internal Dosimetry Team, Technical Issue Paper 018 (TIP 018), "Bioassay Program Enrollment Criteria," 12/21/2007) [SRDB ID: 126283] • LANL, RP-2 Internal Dosimetry Team, Technical Issue Paper 024 (TIP 024), "Dosimetry of Insoluble Metal Tritides," 11/23/2009 [SRDB ID: 126284] • LANL, RP-2 Internal Dosimetry Team, Technical Issue Paper 025 (TIP 025), "Dosimetry of Soluble Metal Tritides," 11/23/2009 [SRDB ID: 126285] • LANL, RP-2 Internal Dosimetry Team, Technical Issue Paper 026 (TIP 026), "Dosimetry of Organically Bound Tritium, "11/23/2009 [SRDB ID: 126286] • LANL, RP-2 Internal Dosimetry Team, Technical Issue Paper 001 (TIP 001), "Analysis of Special Tritium Compounds," 11/23/2009 [SRDB ID: 126282]