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Advisory Board on Radiation and Worker Health
National Institute for Occupational Safety and Health

SC&A Evaluation of Feasibility and Utility of Subcontractor Exposure Potential Comparison

Response Paper

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Prepared by

Bob Barton, CHP

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

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1 Introduction and Background

The Savannah River Site (SRS) Work Group last met on March 23, 2023. During that meeting, a member of the work group proposed that a quantitative comparison be made of the exposure potential between subcontractors and prime contractors (ABRWH, 2023, pp. 114–132). Specifically, a Board member summarized the proposed evaluation as follows:

> suppose you look at the bioassay data of these short-term workers where data does exist. And the . . . point estimate and distribution is way out of hand of what the overall cohort is. That tells me something. If it falls right in the middle, that also tells me something. [ABRWH, 2023, p. 130]

At the conclusion of the March 2023 SRS Work Group meeting, SC&A was tasked with evaluating the feasibility and utility of such a comparison and reporting back to the work group. This report summarizes SC&A's evaluation of feasibility and commentary on the overall utility of such an effort moving forward.

Section 2 gives an overview of the available electronic database records provided by SRS for consideration in this feasibility and utility study. Section 3 describes in further detail those database files that may have merit in answering the proposed question, in particular the bioassay database. Section 4 presents SC&A's perspective on the feasibility of further analysis, and section 5 provides additional commentary on the utility of performing such evaluations. Finally, section 6 summarizes the previous sections for SRS Work Group discussion.

2 Records Available for Analysis

Subsequent to the March 2023 meeting of the SRS Work Group, the National Institute for Occupational Safety and Health (NIOSH) provided SC&A with a suite of data files collectively titled "SRS_ProRad." SC&A found that eight of these files are salient to the proposed comparison of subcontractors and prime contractors; these eight files are described in table 1. Descriptions of the remaining files not listed in table 1 can be found in appendix A.

Table 1. Summary of SRS ProRad data files and relevance to potential subcontractor comparison

File name	# Entries (rows)	Relevant?	SC&A comments
SRS_INDIVIDUAL	165,022	Yes – subcontractor identification	This database contains social security number (SSN), name, termination date, and company for each energy employee (EE). The "company" designation includes whether the EE was a subcontractor or not and identifies Bechtel workers who generally served as the prime contractor construction trade workers. While the termination dates are provided, no hire dates or other work duration information is provided. The listed termination dates span all the way from 1950 through 2023. Finally, in many cases there is a "craft code" listed with the EE's personnel entry.
srs_organ_dose	18,790	Yes – internal dose estimates	This database contains evaluated committed dose equivalent for individual EEs, starting in 1945 and extending through 2022. The file provides each EE's SSN and full name, allowing the identification of subcontractors and prime contractors. Only 484 of the 18,790 entries occurred during the period of interest (1991–1997).
SRS_EXTERNAL_DOSIMETRY_LEGACY	2,071,483	Yes – external dose	Contains external dosimetry (deep, shallow, and neutron dose) results beginning in 1973 and extending through 2003. Area codes are provided beginning in 1982. The file also provides SSN numbers, which would allow the identification of subcontractors and prime contractors. The file does not specify the actual exposure period (i.e., actual wear period) other than indicating the badge cycle when it was assigned and whether it was a visitor, temporary, monthly, or quarterly badge.
SRS_EXTREMITY_DOSE_YTD_SUM	549,986	Yes – external dose	Contains annual extremity dose values for four locations on the body, starting in 1952 and ending in 2023. While the file does not contain SSN numbers, it does contain a unique employee number and full name of the EE that would allow identification of subcontractors and prime contractors.
SRS_EXTREMITY_DOSIMETRY_LEGACY	101,045	Yes – external dose	Contains extremity shallow dose measurements starting in 1990 and includes actual body location (e.g., left ankle, right hand, right wrist, back, chest, etc.). The entries include a facility code and an SSN number that would allow identification of subcontractors and prime contractors.

File name	# Entries (rows)	Relevant?	SC&A comments
SRS_WHOLE_BODY_YTD_DOSE_SUMMARY	605,455	Yes – external dose	This database contains a listing of combined internal and external doses for EEs, starting in 1945 and extending to early April 2023. The database does contain a unique employee ID number and full name that would allow for delineation of subcontractors and prime contractors. However, internal doses are not reported until 2003, though over 115,000 annual external dose records are available for 1991–1997.
SRS_INDV_NONTRITIUM_LEGACY	434,062	Yes – bioassay results	Contains in vitro bioassay results beginning in 1986 and ending in 2004. The major radionuclide categories are plutonium, uranium, and fission products (i.e., Sr-90), as well as trivalent actinides and neptunium. The database contains EE SSNs and names, which allow the identification of subcontractors versus prime contractors. Facility codes are also often included with the bioassay result.
SRS_INCIDENT_DATA_CEDE	3,549	Yes – incident dose evaluation	Lists documented incidents extending from 1945 into 2023. Of the 3,549 entries, 84 pertain to the 1991–1997 period; only 3 of the 84 provide an incident description. While not explicit, the database appears to provide an SSN associated with each entry. Also provided are a security badge number and the full name of the EE involved, which should allow identification of subcontractors and prime contractors.

Of the eight database files described in table 1, "SRS_INDV_NONTRITIUM_LEGACY" is likely the most relevant to the proposed evaluation of subcontractor and prime contractor records, as this would be the vehicle used in development of any subsequent co-exposure model. Section 3 characterizes this database to illustrate the amount of data and worker coverage contained in the dataset for the period of interest (1991–1997).

3 Summary of Bioassay Data (1991–1997)

This section analyzes the main bioassay database, "SRS_INDV_NONTRITIUM_LEGACY," to determine the number of samples and individual workers, by year and radionuclide type, for subcontractors and prime contractors. SC&A only considered nonbaseline urinalysis samples that had a void date from 1991−1997 (or, if a void date was unavailable, the receipt date was used) and did not include fecal samples. Based on these criteria, SC&A identified 238,491 bioassay samples for characterization and notes that only 601 of these samples were greater than zero (~0.25 percent).

The evaluation timeframe of 1991–1997 was chosen to begin where the previous Special Exposure Cohort (SEC) recommendation to include a class of workers (subcontractors) for

Similarly, tables 4 and 5 summarize the total individuals sampled by year and radionuclide for prime and subcontractors, respectively. Similar to the number of bioassay samples in total, the number of individual prime contractors monitored by year was generally 75 to 90 percent.

Table 4. Overview of unique individuals sampled per radionuclide per year for prime contractors

Radionuclide	1991	1992	1993	1994	1995	1996	1997	All years
Trivalent actinides	335 (89.3%)	184 (86.8%)	153 (81.0%)	187 (82.7%)	222 (81.9%)	327 (81.5%)	961 (85.0%)	515 (90.7%)
Np-237	62 (84.9%)	175 (86.6%)	233 (87.6%)	244 (89.1%)	223 (89.2%)	246 (91.8%)	420 (94.0%)	792 (87.2%)
Pu-238, Pu-239	6,425 (73.9%)	7,159 (81.5%)	5,325 (80.6%)	4,562 (80.9%)	4,335 (82.5%)	4,130 (82.7%)	5,111 (103.9%)	11,066 (74.6%)
Sr-90	2,321 (74.7%)	3,517 (80.7%)	2,968 (80.0%)	2,818 (80.5%)	2,866 (81.8%)	2,815 (81.7%)	2,082 (64.0%)	6,803 (77.2%)
Enriched uranium	1,797 (79.3%)	3,051 (81.0%)	2,273 (79.5%)	920 (82.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4,341 (78.8%)
Depleted uranium	14 (82.4%)	3 (75.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	17 (81.0%)
U-234, U-235, U-238	1 (100.0%)	3 (75.0%)	14 (82.4%)	1,562 (78.9%)	1,916 (79.8%)	1,735 (79.1%)	1,852 (90.5%)	2,870 (76.4%)
All uranium	1,800 (79.3%)	3,052 (81.0%)	2,276 (79.5%)	1,972 (78.8%)	1,916 (79.8%)	1,735 (79.1%)	3,150 (153.9%)	5,296 (77.5%)

Table 5. Overview of unique individuals sampled per radionuclide per year for subcontractors

Radionuclide	1991	1992	1993	1994	1995	1996	1997	All years
Trivalent actinides	53 (9.3%)	40 (10.7%)	28 (13.2%)	36 (19.0%)	39 (17.3%)	49 (18.1%)	74 (18.5%)	170 (15.0%)
Np-237	11 (15.1%)	27 (13.4%)	33 (12.4%)	30 (10.9%)	27 (10.8%)	22 (8.2%)	51 (11.4%)	127 (14.0%)
Pu-238, Pu-239	2,273 (26.1%)	1,620 (18.5%)	1,279 (19.4%)	1,079 (19.1%)	922 (17.5%)	864 (17.3%)	831 (16.9%)	3,777 (25.5%)
Sr-90	786 (25.3%)	842 (19.3%)	744 (20.0%)	681 (19.5%)	637 (18.2%)	630 (18.3%)	559 (17.2%)	2,022 (22.9%)
Enriched uranium	470 (20.7%)	717 (19.0%)	587 (20.5%)	195 (17.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1,171 (21.2%)
Depleted uranium	3 (17.6%)	1 (25.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (19.0%)
U-234, U-235, U-238	0 (0.0%)	1 (25.0%)	3 (17.6%)	418 (21.1%)	485 (20.2%)	458 (20.9%)	426 (20.8%)	892 (23.8%)
All uranium	470 (20.7%)	717 (19.0%)	587 (20.5%)	532 (21.2%)	485 (20.2%)	458 (20.9%)	426 (20.8%)	1,560 (22.8%)

Another subgroup of workers that may be of interest for comparison are those employed by Bechtel Savannah River Inc. (“Bechtel”), which served as the construction branch of the prime contractor. The total numbers of samples and individual workers monitored via bioassay for Bechtel are shown in tables 6 and 7, respectively. Similar to the proportion of subcontractor

records, Bechtel employees were generally between 10 and 20 percent of the monitored results and population.

Table 6. Overview of total bioassay samples per radionuclide per year for Bechtel employees

Radionuclide	1991	1992	1993	1994	1995	1996	1997	All years
Trivalent actinides	7 (1.0%)	0 (0.0%)	1 (0.3%)	5 (1.2%)	12 (1.1%)	80 (7.0%)	157 (8.1%)	262 (4.3%)
Np-237	22 (16.1%)	76 (23.4%)	58 (18.1%)	35 (12.1%)	12 (4.2%)	7 (2.4%)	17 (2.3%)	227 (9.4%)
Pu-238, Pu-239	1,964 (15.6%)	2,383 (17.3%)	1,319 (13.2%)	893 (10.6%)	701 (9.1%)	499 (7.3%)	579 (6.3%)	8,338 (12.2%)
Sr-90	1,055 (29.4%)	2,658 (33.0%)	1,062 (20.6%)	825 (17.5%)	619 (13.7%)	401 (10.0%)	305 (8.6%)	6,925 (20.6%)
Enriched uranium	532 (14.1%)	1,588 (26.6%)	776 (17.0%)	190 (15.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Depleted uranium	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
U-234, U-235, U-238	0 (0.0%)	0 (0.0%)	2 (11.8%)	349 (11.5%)	486 (11.2%)	351 (9.7%)	362 (10.2%)	1,550 (10.6%)
All uranium	532 (13.9%)	1,588 (26.5%)	782 (16.9%)	1,237 (11.9%)	1,458 (11.2%)	1,053 (9.7%)	1,086 (10.2%)	7,736 (13.0%)

Table 7. Overview of unique individuals sampled per radionuclide per year for Bechtel employees

Radionuclide	1991	1992	1993	1994	1995	1996	1997	All years
Trivalent actinides	8 (1.4%)	2 (0.5%)	2 (0.9%)	3 (1.6%)	5 (2.2%)	21 (7.7%)	36 (9.0%)	53 (4.7%)
Np-237	18 (24.7%)	45 (22.3%)	51 (19.2%)	36 (13.1%)	11 (4.4%)	7 (2.6%)	14 (3.1%)	119 (13.1%)
Pu-238, Pu-239	1297 (14.9%)	1,588 (18.1%)	933 (14.1%)	668 (11.8%)	511 (9.7%)	390 (7.8%)	328 (6.7%)	2,387 (16.1%)
Sr-90	985 (31.7%)	1,304 (29.9%)	719 (19.4%)	566 (16.2%)	460 (13.1%)	343 (10.0%)	273 (8.4%)	1,840 (20.9%)
Enriched uranium	514 (22.7%)	1,113 (29.5%)	603 (21.1%)	183 (16.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1,396 (25.3%)
Depleted uranium	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
U-234, U-235, U-238	0 (0.0%)	0 (0.0%)	3 (17.6%)	287 (14.5%)	336 (14.0%)	261 (11.9%)	213 (10.4%)	534 (14.2%)
All uranium	514 (22.6%)	1,113 (29.5%)	603 (21.1%)	391 (15.6%)	336 (14.0%)	261 (11.9%)	213 (10.4%)	1,499 (21.9%)

4 Feasibility and Potential Path Forward

As noted in section 3, access to an electronic set of bioassay data is available for the period of interest (1991–1997). Drawing on past experience with similar analytical efforts, SC&A believes that the most relevant example is found in ORAUT-RPRT-0102, revision 00 (ORAUT, 2021; "RPRT-0102"), which compares the magnitude of plutonium (Pu-238 and Pu-239) bioassay

results for four different groups of workers at the Los Alamos National Laboratory (LANL): (1) Johnson Controls (JC), (2) Environmental Safety and Health (ESH), (3) Nuclear Materials Technology (NMT), and (4) other workers not fitting into the prior three categories.

Such a comparison is relatively simplistic because it only compares the magnitude of plutonium in urine (rather than a metric specific to individual workers) over several years at LANL (1996–2001). Drawbacks to this type of analysis include:

- Does not account for potential data dominance.
- Does not look at more specific time periods (e.g., annual).

For the first bullet, SC&A notes that a time-weighted one-person-one-statistic (TWOPOS) approach could be employed to account for situations in which individual employees may have submitted significantly more samples during the desired evaluation period compared to the majority of monitored employees over the same period. For the second bullet, SC&A recommends that any potential analysis be performed at yearly intervals since the primary question under consideration is not only whether SEC-0103 should be extended but also, if it is extended, what would be an appropriate cutoff point post 1990?

In addition, the work group may want to consider expanding the analysis to other radionuclides described in section 3 of this report (e.g., strontium (Sr)-90, U-238, U-235, Am/Cm/Cf, and neptunium (Np)-237). Finally, it may be possible for at least some of these radionuclides to be parsed not only by year and worker type (subcontractor and prime contractor) but also by work area. However, this level of granularity may make reaching any conclusions based on the available dataset more problematic (e.g., if plutonium was higher for one group in A Area but lower for the same group in F Area).

SC&A recommends that, if the work group elects to proceed with such a comparison, NIOSH/Oak Ridge Associated Universities Team (ORAUT) may be in the best position to perform the analysis. NIOSH already develops co-exposure models that would contain the same essential steps as the comparison suggested previously in this section. During the March 2023 work group meeting, NIOSH has already indicated that the process would be relatively easy, specifically:

> I believe that what Dr. Lockey's referring to would be a coexposure model. I would point out that we have not finalized that development yet, but we could do so relatively quickly -- well, I believe relatively quickly, or at least get something on paper. [ABRWH 2023, p. 115]

In addition, as noted previously, the vast majority of relevant bioassay entries (i.e., greater than 99 percent) were zero or negative, which would necessitate using multiple imputation in any sort of quantitative comparison. Should the work group elect to proceed with the comparison study, it seems the most efficient path forward in any potential analysis would be for NIOSH to use its established modules for calculating the TWOPOS values of the groups of interest.

5 SC&A Commentary on Utility of Proposed Comparison

SC&A noted during the March 2023 SRS Work Group meeting that it has reservations concerning the utility of such a subcontractor comparison because it may not fully illuminate the primary SEC issue being discussed (ABRWH, 2023, pp. 120–121, 124–125, 129). These reservations were also echoed by the work group chairperson (ABRWH, 2023, pp. 117–118, 123, 128). Recent SEC discussions involving SRS recommended the addition of a class of workers up through 1990 based on the uncertainty around the appropriate collection and analysis of radiation work permit (RWP) job-specific bioassay. This uncertainty would most likely disproportionately affect subcontractors, whose work may have been transient and short term but of potentially higher exposure potential than the prime contractors who were more likely to be on a routine monitoring program.

As noted in section 3, SC&A was able to separate electronic bioassay records for subcontractors and prime contractors. However, SC&A was not able to identify job-specific bioassay records within the available dataset (i.e., there is no specific designation for RWP-driven job-specific bioassay). Given the noted deficiencies identified in the collection of job-specific bioassays (i.e., only 21 percent compliance with the program, as identified in the late 1990s), along with the small fraction of job-specific bioassays compared to routine bioassays (NIOSH, 2020), it is logical to assume that any such comparison of electronic records would primarily be for those on a routine monitoring program. Therefore, it is SC&A's opinion that such a comparison may not sufficiently inform the work group as to what the missing[1] RWP-job-specific bioassays may have indicated as far as exposure potential.

SC&A also notes that NIOSH compared exposure potential between subcontractors and prime contractors in the report, "Practical Implications of the Bootstrap Uncertainty Analyses on Co-exposure Models" (NIOSH, 2021), for the period 1972–1990. That report concluded, in part:

> Subcontractor CTWs [construction trade workers] exposures were generally lower than prime CTWs between 1972 and 1990, however there is no practical difference between subcontractor CTWs and the current combined CTW model. [p. 7]

NIOSH (2021) was presented to the SRS Work Group on March 23, 2021, and also to the full Advisory Board on Radiation and Worker Health ("Board," ABRWH) on April 15, 2021, at which time the Board voted to recommend subcontractors at SRS be added as an SEC class.

[1] In this instance, "missing" refers to the Westinghouse Savannah River Company and U.S. Department of Energy findings of noncompliance with the RWP-driven job-specific bioassay, *not* that the bioassays were collected/analyzed but are simply unavailable.

6 Summary Conclusions

SC&A's evaluation of the potential for a meaningful comparison of prime and subcontractors identified the following conclusions:

- A suite of database files was provided by SRS and contained various dosimetry information, including external dosimetry, internal bioassay monitoring, incident documentation, employee information (e.g., subcontractor or prime contractor), facility designations, and radiation work permit information.

- Eight of the files contained information relevant to any potential comparison of exposure potential between subcontractors and prime contractors.

- The most relevant database file contained 238,491 bioassay results for both subcontractors and prime contractors during the period of interest (1991–1997), of which only ~0.25 percent of the total bioassay results had results greater than zero.

- Bioassay results measured the following radionuclides: trivalent actinides, neptunium, plutonium, strontium, and uranium.

- Subcontractors generally represented 0–20 percent of the population monitored via bioassay (i.e., prime contractors represented 80–90 percent of the population monitored via bioassay).

- The prime contractor construction branch (Bechtel Savannah River Inc.) also generally represented 10–20 percent of the population monitored via bioassay.

- SC&A believes the best potential path forward would be to calculate the TWOPOS values by year for the groups of interest (e.g., subcontractors, prime contractors, prime construction workers).

- The most efficient execution of any comparison study is likely to be performed by NIOSH, as the framework is already in place via standard co-exposure modeling modules currently used by NIOSH as well as methods for dealing with the large portion of zero or less-than-zero results.

- SC&A maintains that any potential comparison may not reflect the exposure potential of the RWP-driven, job-specific bioassay, which had notable incompleteness (i.e., only 21 percent compliance as found in 1997) and was the basis for the Board recommending the inclusion of an SEC class for subcontractors for 1972–1990.

7 References

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Appendix A: ProRad Database Files Not Relevant to Potential Comparison of Subcontractor and Prime Contractor Exposure Potential

Table A1. Summary of ProRad files not relevant for subcontractor and prime contractor exposure analyses

File name	# Entries (rows)	Relevant?	SC&A comments
SRS_[various years]_PRORAD_SIGN_IN_DATA	4,497,761	No – out of period	Contains a series of six databases (parsed by time period because of their size) that contain RWP sign-in/sign-out times, thermoluminescent dosimeter (TLD) numbers, and accrued dose during the indicated period. However, these files are out of the period of interest as they represent RWP sign-in sheets from January 2004 through April 2023.
SRS_AREA_MONITORING_FACILITIES	774	No – out of period	Contains area code designations used at SRS 2000−2023 (e.g., area code F087 represents the 235-F Office 202-B starting in 2004).
SRS_EXTERNALDOSIMETRY_VISITOR_LEGACY	34,749	No – out of period	Contains a list of visitor badges issued starting in 1966 through May 1990.
SRS_EXTREMITY_DOSE_CYCLE_SUMMARY	81,147	No – out of period	Contains annual extremity dose values for various locations on the body (e.g., upper left extremity quadrant, lower left quadrant, etc.) beginning in 2004.
SRS_EXTREMITY_DOSE_DETAIL	302,375	No – out of period	Contains specific extremity dosimeter results, as well as whole-body dosimeter results during the same wear period, starting in 2004.
SRS_FACILITY	28	Unknown – undated	Contains an undated short list of mainly non-numerical facility codes for the A Area.
SRS_FETAL_DOSE	1,491	No – out of period	Contains dosimetry information, including whole-body dosimeter and fetal monitoring measurements. The records begin in 2003.
SRS_INDIVIDUAL_LGCY	10,704	Unknown – undated	Contains a list of SRS visitors by name and SSN; however, no dates are provided.
SRS_INDV_INVITRO_SAMPLES	332,390	No – out of period	Contains in vitro bioassay results beginning in November 2003 and ending in 2011.
SRS_INDV_TRITIUM_LEGACY	857,050	No – out of scope	Contains individual tritium urinalysis results beginning in 1989 and ending in 2003. SC&A notes that the primary evaluation of job-specific bioassay completeness (ORAUT, 2019) specifically omitted tritium monitoring as not being relevant to SEC discussions; therefore, SC&A finds the data contained in this database are not relevant in the context of this report.
SRS_Invivo_Count	46,037	No – lacking dose information	Contains a list of whole-body and chest count dates by EE (including the name and SSN). The file does not contain any results.

File name	# Entries (rows)	Relevant?	SC&A comments
SRS_LIFETIME_DOSE_SUM	165,022	No – lacking period specific data	Contains a single listing for individual EEs by unique employee number and contains the accrued dose over, presumably, their entire employment at SRS (no dates are given). Dose data include deep dose, committed effective dose equivalent from both tritium and non-tritium intakes, offsite dose, and the sum of all three dose assessments.
SRS_RWP	27,810	No – out of period	Contains information on specific RWPs, including the activation and expected closure date, type (standing work permit or job-specific permit), area, survey information, measured contamination, etc. However, the database does not begin until October 2003.
SRS_RWP_REQUEST	12,508	No – out of period	Contains a list of RWP requests including a description of the work to be performed, location, estimated length, required equipment, potential hazard descriptions, etc. However, the database does not begin until October 2003.
SRS_RWP_REQUIRED_ANALYSIS	270,334	No – out of period	Explicitly identifies the RWP number and the required bioassay analysis to be performed. However, the database does not begin until October 2003.
SRS_RWP_TASK	132,887	No – out of period	Contains a list of RWPs and an associated four-digit number to describe the task (the database also contains sporadic written comments describing the RWP task) as well as estimates of the accrued external dose that is to be expected when performing the individual tasks. However, the database does not begin until October 2003.
SRS_TLD_Area_assigns	84,558	No – out of period	Contains a list of dosimeter issuance dates, locations, and results. The database does not appear to identify any specific EEs who wore each dosimeter; rather, it lists the employee number of the EE who issued the badge. However, the entries do not begin until December 2003.
SRS_TLD_ASSIGNS (also listed as SRS_TLD_ASTMT)	744,409	No – out of period	Contains a list of dosimeter issuance to individual EEs that includes a unique employee number, facility code, issue/return dates, and monitoring results (deep, lens of the eye, shallow, and neutron dose). However, the entries do not begin until January 2004.
SRS_WHOLE_BODY_DOSE_DETAIL	484,520	No – lacking dose information	Contains a list of combined internal and external doses for EEs starting in 1945 and extending to early April 2023. The database does contain a unique employee ID number and full name that would allow identification of subcontractors and prime contractors. It should be noted that dose breakdowns by pathway (deep dose, shallow dose, neutron dose, tritium intake and non-tritium intake) are not apparent until 2003. Only 93 of the 484,520 entries are during the period 1991–1997.