



Savannah River Site Subcontractor Monitoring Update

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Advisory Board on Radiation and Worker Health (ABRWH) Meeting
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Overview

- NIOSH / SC&A Subcontractor Analysis
- NIOSH concerns with SC&A Subcontractor Monitoring Report
 - 30 / 90 day criteria
 - Re-evaluation of SC&A Data
 - NOCTS Subcontractor Monitoring Data
 - 10 CFR 835 Internal Monitoring and SRS Monitoring Program
 - Review of the 10 CFR 830 Notice of Violation (NOV)
- Status of Issues

Re-Cap NIOSH Job Plan Analysis

- Evaluated Job-Plans that required respiratory use
 - 68% of subcontractors have direct monitoring data
 - 92% of the subcontractors have either direct monitoring or a co-worker on the same RWP was monitored
- NIOSH concluded that a Co-worker model would be sufficiently accurate
 - Evaluated for bias and other considerations

SC&A Subcontractor Report - Overview

- SC&A full analysis of all RWPs in the 1990s found:
 - 30 day post RWP (201/306) – 66% compliance rate
 - 90 day post RWP (244/306) – 80% compliance rate

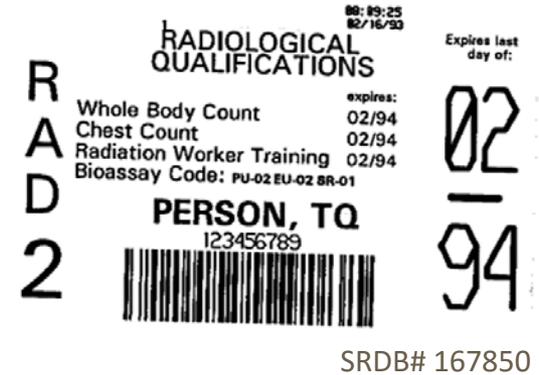
- When RWP specifically indicated Bioassay
 - 30 day post RWP (140/197) – 71% compliance rate
 - 90 day post RWP (166/197) – 84% compliance rate

NIOSH Review of SC&A Report

- Use of 30 day and 90 day criteria for bioassay
 - 30 day is appropriate for tritium
 - 100 mrem tritium dose still detectable after 70 days
 - Per procedure, annual monitoring was usually the requirement for non-tritium (actinide samples) thus SC&A excluded a significant number of monitored subcontractors from their analysis and indicated they were not monitored when in fact they were monitored.
- *A more fitting analysis would divide bioassay data into tritium and non-tritium categories and used appropriate time interval for each category*

1990s SRS Radiological Work Control and Bioassay Monitoring

- Worker attends Rad Worker II training
- Worker signs into RWP
- Worker checks the bioassay codes on the Radiological Qualifications Badge (RQB) against the RWP requirements for bioassay
- Worker conducts their work
 - Worker leaves bioassay based on either routine schedule or job-specific requirement



Bioassay Codes

Pu-02 (Plutonium 2/yr)

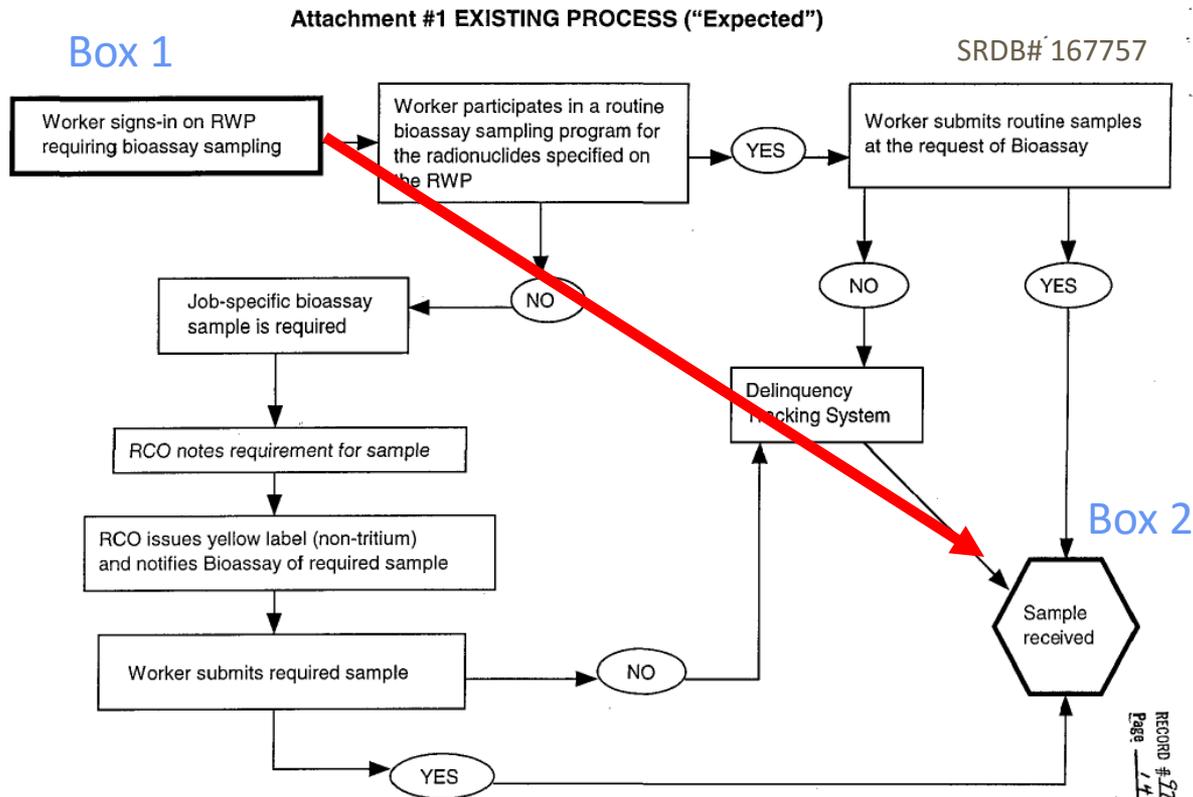
EU-02 (Enriched Uranium, (2/yr)

Sr-90 (Strontium-90, 1/yr)

Bioassay Monitoring

SC&A evaluation jumps from Box 1 to Box 2 and checks to see if they have a sample within 30 or 90 days of sign in date

If a subcontractor was not scheduled to leave a sample for another 100 days there won't be a sample but worker was monitored.



A significant fraction if not majority were monitored via routine based on their Radiation Qualification Badge (RQB)

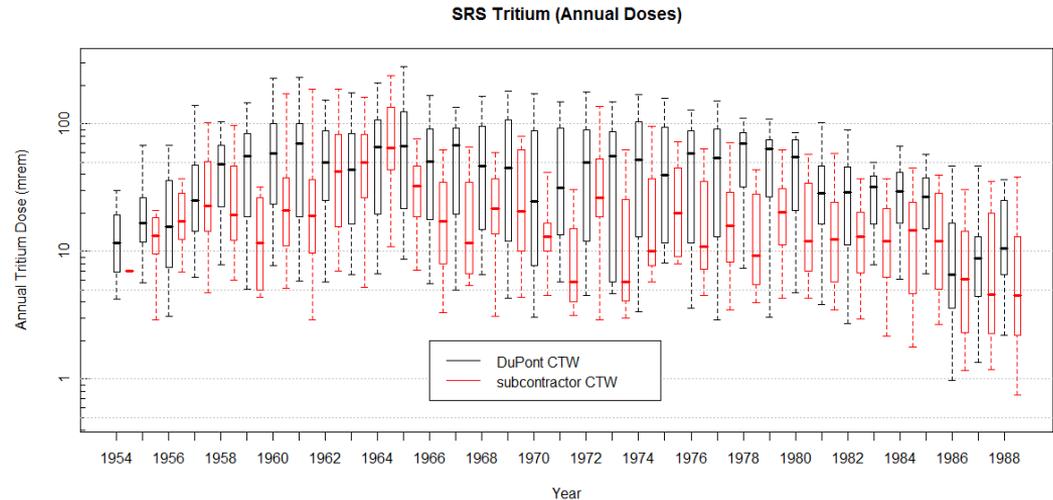
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NIOSH Re-evaluation of SC&A Report data – Tritium

- NIOSH Re-evaluation
 - 108/119 (90.8%) subcontractors on RWPs that have potential for tritium exposure have bioassay data
 - Mean number of days between RWP and bioassay **7.5** days
 - 89.2% on routine prescheduled monitoring (T-30)
 - 117/119 (98%) covered by either personal data or a co-worker working on the same RWP had a sample

NIOSH Re-evaluation of SC&A Report data – Tritium

- Since 1973 the 95th percentile subcontractor tritium dose has been less than 100 mrem with a downward trend



- Since 1980 the DuPont CTWs 95th percentile tritium dose has been less than 100 mrem with a downward trend.
- Conclusion tritium monitoring of subcontractors is not a dose reconstruction issue at SRS.

NIOSH Re-evaluation of SC&A Report data – Non-tritium

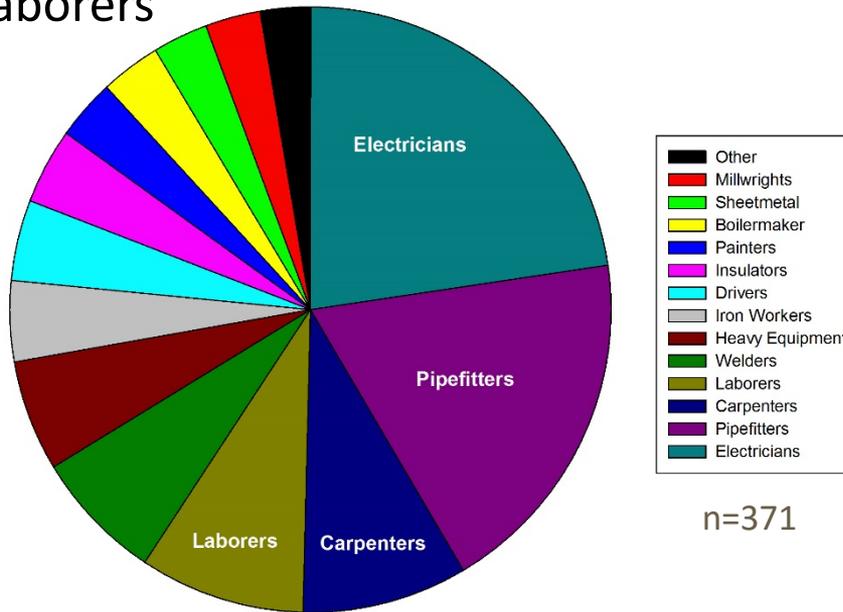
- NIOSH Re-evaluation found 102 subcontractors on RWPs that have potential for plutonium exposure
 - 89/102 (87.3%) have bioassay data
 - Mean number of days between RWP and bioassay **125.4** days
 - 80.4% on routine prescheduled monitoring
 - 100/102 (98%) covered by either personal data or a co-worker who signed in on the same RWP has a bioassay sample

NIOSH Evaluation of NOCTS data

- *Queried NOCTS to identify workers with Construction Trades Worker (CTW) job titles (412 claimants) between 1991 - 1997*
- *Reviewed each claim to determine whether they were subcontractor or prime*
 - *Removed all WSRC CTWs (formerly DuPont Construction) that were electricians, millwrights, and mechanics.*
 - *Removed WSRC crane operators (canyon) and riggers who primarily worked in the separations area.*
- *Identified 371 claimants who were subcontractor CTWs between 1991 and 1997*

Distribution – by Craft

- 59% are Electricians, Pipefitters, Carpenters and Laborers



n=371

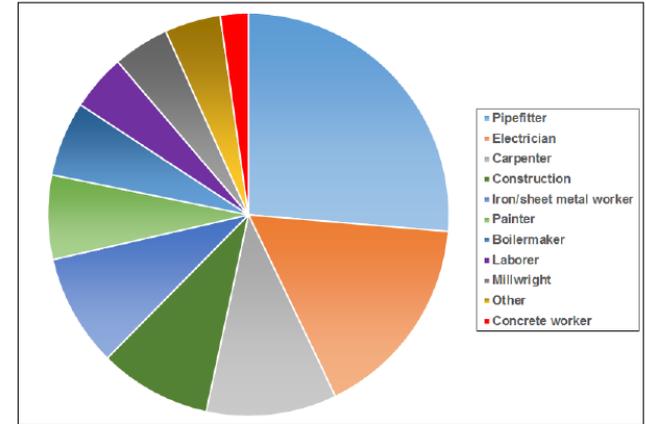


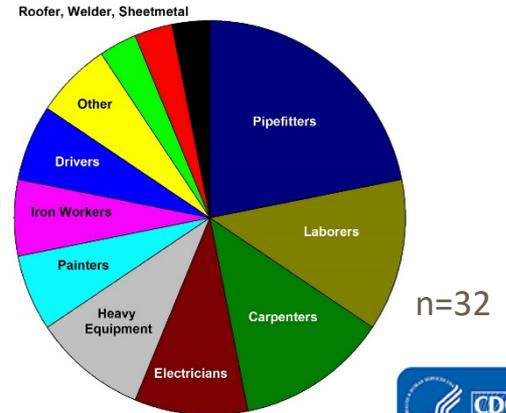
Figure 4-2. Crafts identified in Job Plans used for evaluation of bioassay monitoring.

n=88

Same relative proportions as craft distribution in the 1980s Job Plan Analysis (ORAUT-RPRT-0083)

NIOSH Evaluation of NOCTS data

- 339/371 (91.4%) Subcontractors have some form of internal monitoring (non-tritium or tritium *in vitro* bioassay, or *in vivo* bioassay) during their work at SRS between 1991 and 1997
- Only 32 subcontractors in NOCTS have no internal monitoring data
- Of these only 4 have external monitoring indicating radiological work
- NIOSH believes that the monitoring data from the 339 monitored workers can be used to bound the dose to the 32 (8.6%) unmonitored workers



NIOSH Evaluation of NOCTS Subcontractor Data

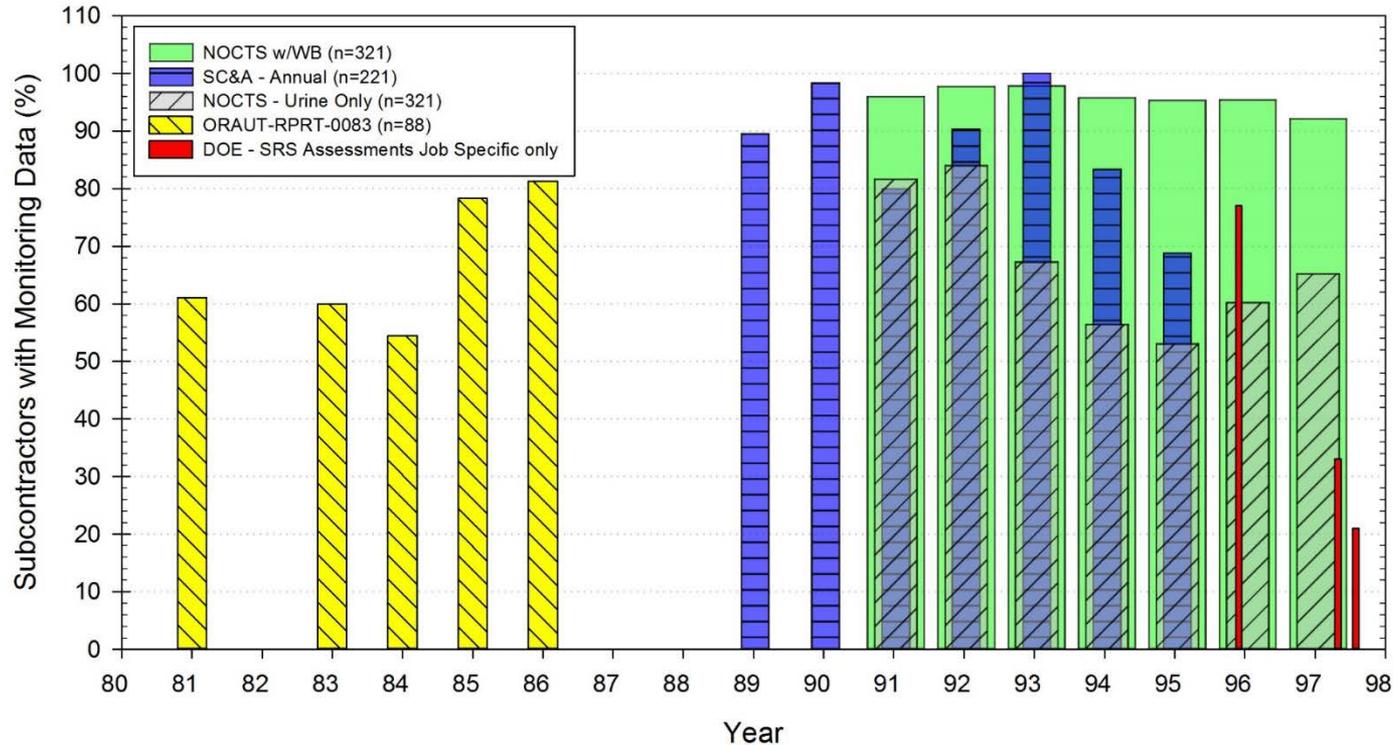
	1991	1992	1993	1994	1995	1996	1997
Total Workers	348	284	250	198	181	139	112
w/ External Monitoring	321	262	229	165	149	108	89
non-H3 Bioassay	205	193	123	83	69	56	49
H3 Bioassay	173	120	90	29	21	23	21
Whole Body Count	278	233	204	152	137	88	64
w/ Internal Monitoring	308 (95.9%)	256 (97.7%)	224 (97.8%)	158 (95.8%)	142 (95.3%)	103 (95.4%)	82 (92.1%)
# External Monitoring - No Internal Monitoring	13	6	5	7	8	5	7

Details of NOCTS Internal Monitoring Data cont.

Contractor	Craft	1991	1992	1993	1994	1995	1996	1997
Const	Electrician	No extern	No extern	No extern				
BSRI/Elect	Electrician	1	1	1	1	1		
BSRI/Paint	Painter	1	1	1	H3	H3	1	H3
Const	Electrician	H3						
BSRI/Labor	Laborer	1	1	WB	WB	WB	No extern	No extern
Const	Heavy Equipment				No extern			
Const	Electrician	1						
BSRI/INS	Insulator	WB	1	WB	No extern			
BSRI/Pipe	Pipefitter	1	1	1	1	1	1	
Const	Electrician	1						
BSRI/Paint	Painter	1	1	WB			No extern	
Const	Electrician	H3						
BSRI/SIW	Welder	1	1	WB	H3	1		
BSRI/CMR	Sheet Metal		1	1	1	1	1	1
BSRI/Labor	Laborer	1	1	H3	WB	1	1	1

1 = Actinide urine bioassay, H3 = Tritium urine bioassay, WB = Whole Body Count,
No extern = No external monitoring

Comparison of Multiple Evaluations



Issue: Incomplete Subcontractor Data for co-worker

- *SC&A concludes that the bioassay dataset for CTW subcontractors, specifically, and CTWs, generally, is demonstrably incomplete for 1989–1998 (and likely before that time period) and does not satisfy the criteria set forth in NIOSH’s Draft Criteria for the Evaluation and Use of Coworker Datasets (NIOSH 2015).*
- We respectfully disagree.
 - We believe that 90.8% and 87.3% direct monitoring for subcontractors is not “*demonstrably incomplete*” and does satisfy criteria set forth in the Implementation Guide.
 - NOCTS data indicates that subcontractors were monitored. Evaluation indicates that 91.6% of the subcontractors who are claimants 1991-1997 have some form of internal monitoring data (*in vitro* and/or *in vivo*).

10 CFR 835.402(c)(1) Individual Monitoring

- (c) For the purpose of monitoring individual exposures to internal radiation, internal dose evaluation programs (including routine bioassay programs) shall be conducted for:
 - (1) Radiological workers who, under typical conditions, are likely to receive 0.1 rem (0.001 Sievert) or more committed effective dose equivalent, and/or 5 rems (0.05 Sievert) or more committed dose equivalent to any organ or tissue, from all occupational radionuclide intakes in a year

10CFR835 (1997)

DOE- STD-1128-98 Section 5.3.2 Monitoring Requirements and Selection of Employees (for Bioassay Program)

- *Workers who are considered likely to have intakes resulting in excess of 100-mrem CEDE are required to participate in a bioassay program. However, because of the extensive radiological control practices for plutonium facilities, including a high degree of engineered barrier containment, **no typical plutonium worker is likely to have intakes of 100-mrem CEDE or more.** However, this should not be used as an excuse to exclude workers from routine bioassay. Although no one should be considered likely to have intakes resulting in 100-mrem CEDE, **some workers** are at significantly higher risk for incurring an intake than others and **should be on routine bioassay.***
- This is the standard today
 - (original June 1998, reaffirmed May 2003, small changes Feb 2005)

Radiological Control - Defense in Depth

- SRS used a Defense in Depth approach to Radiological control with the intention to prevent non-tritium intakes (SRDB# 167851)
 1. Policy (zero intake policy)
 2. Engineered Controls
 3. Procedural Controls
 4. Personnel Protective Equipment (PPE)
 5. Surveillance used to verify Engineering, Procedural, and PPE
 - Air Monitoring
 - Facility Contamination Surveys
 - Personnel Contamination Surveys
 - Routine Bioassay

10 CFR 830 Notice of Violation - Follow-up Data Requests

- NIOSH requested information from both DOE-HQ and SRS regarding this violation to learn more information
 - SRS provided over 1000 pages of information
 - DOE-HQ provided just the final NTS report (8 pages) and indicated that they did not retain any other information related to this violation
- NIOSH sent a follow-up request to SRS on Sept 2017 specifically requesting internal assessments in 1994, 1995, 1996 and 1997 that were listed in the NTS report as well as other documents.
 - Due to funding issues SRS has been delayed in looking for these assessments. The site is currently working on locating the information.

DOE Notice of Violation – 10 CFR 830.120

- 10 CFR 830.120(c)(2)(i) requires that work be performed to established administrative controls using approved procedures.
- 10 CFR 830.120(c)(1)(iii), Quality Improvement, requires that (1) processes to detect and prevent quality problems be established and implemented; (2) that items, services and processes that do not meet established requirements be identified, controlled and corrected according to the importance of the problem and the work affected; and (3) that correction shall include identifying the causes of problems and working to prevent recurrence.

SRDB# 167497



DOE Notice of Violation 10 CFR 830.120(c)(2)(i)

- However, between January 1, 1996, and September 20, 1997, WSRC Facility Evaluation Board reports identified that (1) workers were on incorrect bioassay programs, as identified by their RQB and consequently did not submit job-specific bioassay samples as required; (2) line management did not always ensure that new employees were placed on the correct bioassay schedule, the Bioassay Schedule Report was not always provided to line management for accuracy review, and job-specific bioassay sampling requirements were not always identified on RWPs; and (3) bioassay assignments were not always reviewed when personnel received an annual whole body count.
- This violation constitutes a Severity Level II problem.
- Civil Penalty - \$37,500

DOE Notice of Violation – incorrect bioassay

- WSRC Facility Evaluation Board reports identified that **(1) workers were on incorrect bioassay programs, as identified by their RQB and consequently did not submit job-specific bioassay samples as required;**
- Corrective Action
 - SRS sent 4000 form letters on February 19, 1998 and mailed them to every site employee and subcontractor currently on a routine bioassay program asking them to compare the bioassay codes on their RQB and those listed in the letter. (ESH-HPT-98-0134) (SRDB# 167757, p. 49)
 - Less than 100 discrepancies were identified (< 2.5%).

DOE Notice of Violation 10 CFR 830.120(c)(1)(iii)

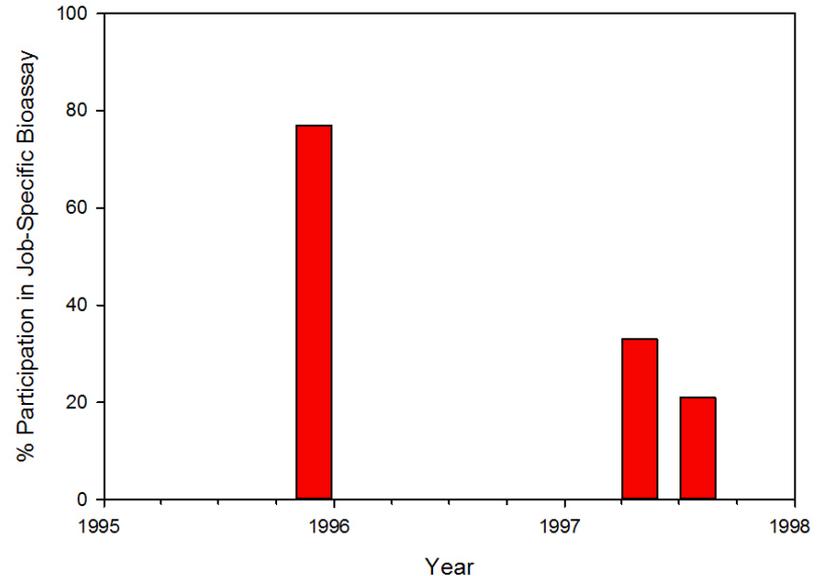
- Contrary to the above, processes to detect and prevent quality problems were not adequately established and implemented and corrective actions did not prevent recurrence in that in **November 1995, DOE identified to WSRC that radiation work permit-prescribed bioassay sampling requirements were not effectively implemented in that 23 percent of workers did not submit bioassay samples as required.** Corrective actions were implemented by WSRC. However, the corrective actions were not effective to prevent recurrence in that non-participation by radiation workers in the job-specific portion of the bioassay program continued through 1996 and increased to a level of non-participation of 79 percent by the second quarter of 1997.
- This violation constitutes a Severity Level II problem.
- Civil Penalty - \$37,500

SRDB# 167497



SC&A “...chronic history of wide noncompliance...”

- Nov 1995 to July 1997 is 26 months
- Three data points in this time period
 - Nov 1995 – 77% participation
 - April 1997 – 33% participation
 - July 1997 – 21% participation
- This is just the Job-Specific component of the surveillance monitoring



Routine Bioassay

- Used to a check to verify effectiveness of procedural and engineered controls
- Trigger for-cause bioassay programs
- Requested from workers who have a **reasonable potential for intakes** but who SRS was confident did not have intakes in excess of 2% of the annual limit

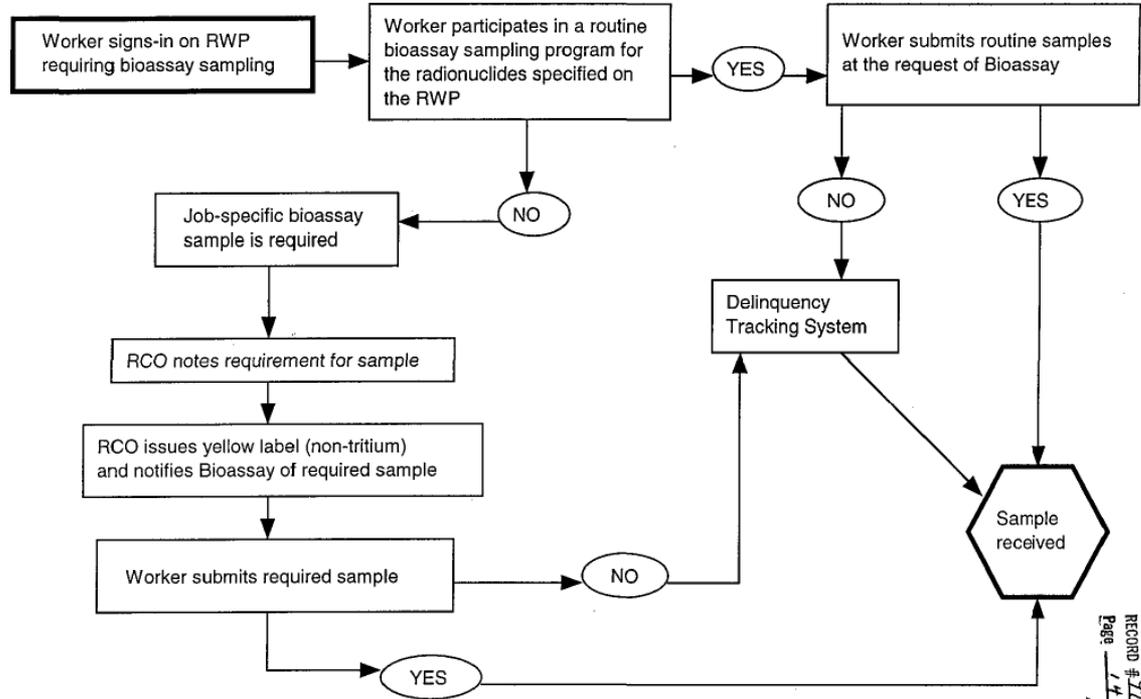
SRDB# 167851

- *“WSRC further stated that the workers themselves were the last line of defense in the workplace indicator program which was the reason why a confirmatory program for workers was conducted.”* (SRDB# 167497)

Attachment #1 EXISTING PROCESS ("Expected")

"Expected" Monitoring

This is what SRS thought was happening



SRDB# 167757

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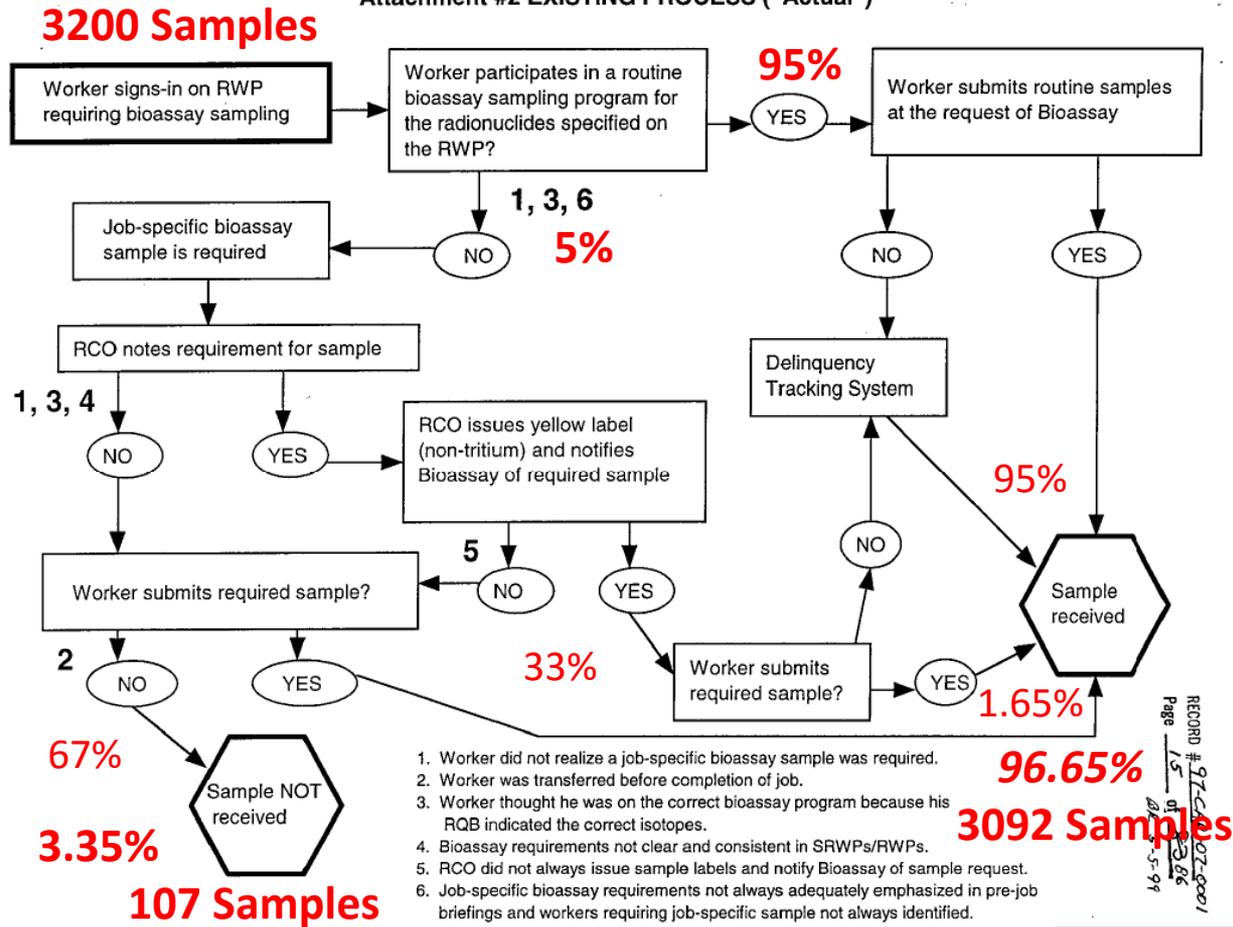
Actual Subcontractor Monitoring

Limited assessment of 3200 bioassay requirements – 33% compliance on Job specific bioassay

Full assessment of ???? bioassay requirements – “about 21% compliance” on Job specific bioassay

1997 Total # of samples NOT received was 256

Attachment #2 EXISTING PROCESS (“Actual”)



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SRDB# 167757



SRS Bioassay Monitoring (Routine Actinide Samples)

- Table indicates very good radiological control to prevent actinide intakes
- SRS internal dosimetrist also indicated that bioassay was final confirmation that controls were working.

	1996	1997	1998 (mid July)
Number of Samples Requested	8132	9389	5251
Number of Samples Received	8062 (99.1%)	9053 (96.4%)	4864 (92.6%)
Number Initially Positive	79 (0.98%)	105 (1.2%)	82 (1.7%)
Number of Confirmed Intakes	2 (0.025%)	2 (0.022%)	0

SRDB# 167851

SRS Bioassay Monitoring (Job Specific Actinide Samples)

- Total number of samples requested at SRS in 1997
 - 9389 Routine (86%)
 - + 1500 Job Specific (14%)
 - 10889 total samples
- 256 workers were initially missed under the Job Specific sampling and required follow-up
- Follow-up indicated that none received an intake

	1997	1998 (mid July)
Number of Samples Requested	1500 (approx.)	564
Number Positive	0	0
Number of Confirmed Intakes	0	0

SRDB# 167851

SRS Bioassay Monitoring (Special Actinide Monitoring)

- These samples were taken “for cause”
- Surveillance (workplace indicators) indicated that something happened and triggered a concern

	1996	1997	1998 (mid July)
Number of Samples Requested	134	249	100
Number of Samples Received	134	249	100
Number of Confirmed Intakes	9 (6.7%) 6 >100mrem	3 (1.2%) 2 >100mrem	0

SRDB# 167851

Implications for Dose Reconstruction under EEOICPA

- NIOSH respectfully disagrees with SC&A's conclusion that this notice of violation would prohibit dose reconstruction of subcontractor construction trades workers.
 - The job-specific bioassay in conjunction with the routine monitoring was used for surveillance to confirm adequacy of workplace monitoring and controls.
 - Routine or prescheduled bioassay monitoring was the primary method of bioassay surveillance as indicated by the large number of workers on routine bioassay compared to job-specific bioassay
 - The number of intakes at the site is very low (less than 0.1%) in this time period

Implications for Dose Reconstruction under EEOICPA

- DOE acknowledged rigorous radiological control program during enforcement meeting

*“DOE is aware that, for all radionuclides other than tritium, the WSRC internal dosimetry program does not knowingly permit any worker to be exposed to airborne radioactive material. **Further, it is noted that WSRC has implemented a rigorous program for the comprehensive use of field indicators during work activities to signal that an unexpected radiological condition may have led to potential occupational intakes of radioactive material by a worker.**”*

Nonetheless, DOE also appreciates that the potential exists to overlook worker exposures to radioactive material due to unrecognized field conditions or other types of personnel error. (SRDB 167497)

Implications for Dose Reconstruction under EEOICPA

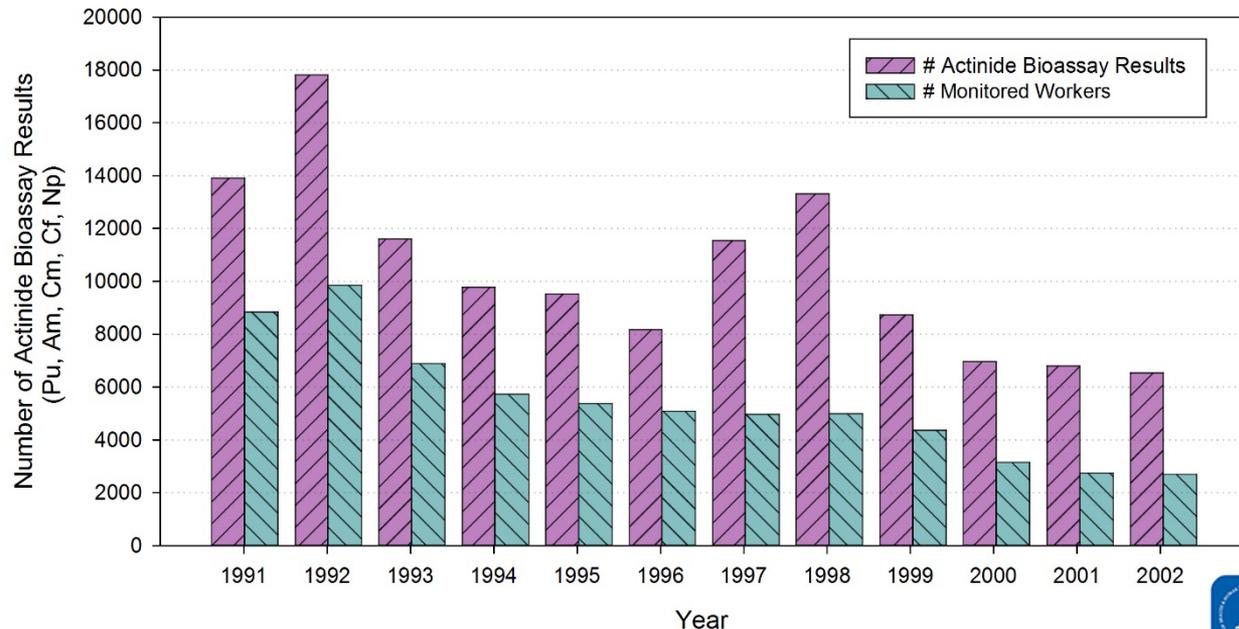
- With the follow-up sampling of the 256 workers conducted by the site, there is no missing bioassay in 1997 regardless of the initial 67% non-participation rate under the “*limited assessment*” and 79% nonparticipation rate under the “*full assessment*”.
 - There is NO effect on the co-worker model for 1997 as all of the worker data has been collected and evaluated.
 - There were no intakes of radioactive material
- The site evaluated the potential for those who may be missing samples in 1996 and concluded that they did not have a potential for intake. (SRDB# 167497)

Implications for Dose Reconstruction under EEOICPA

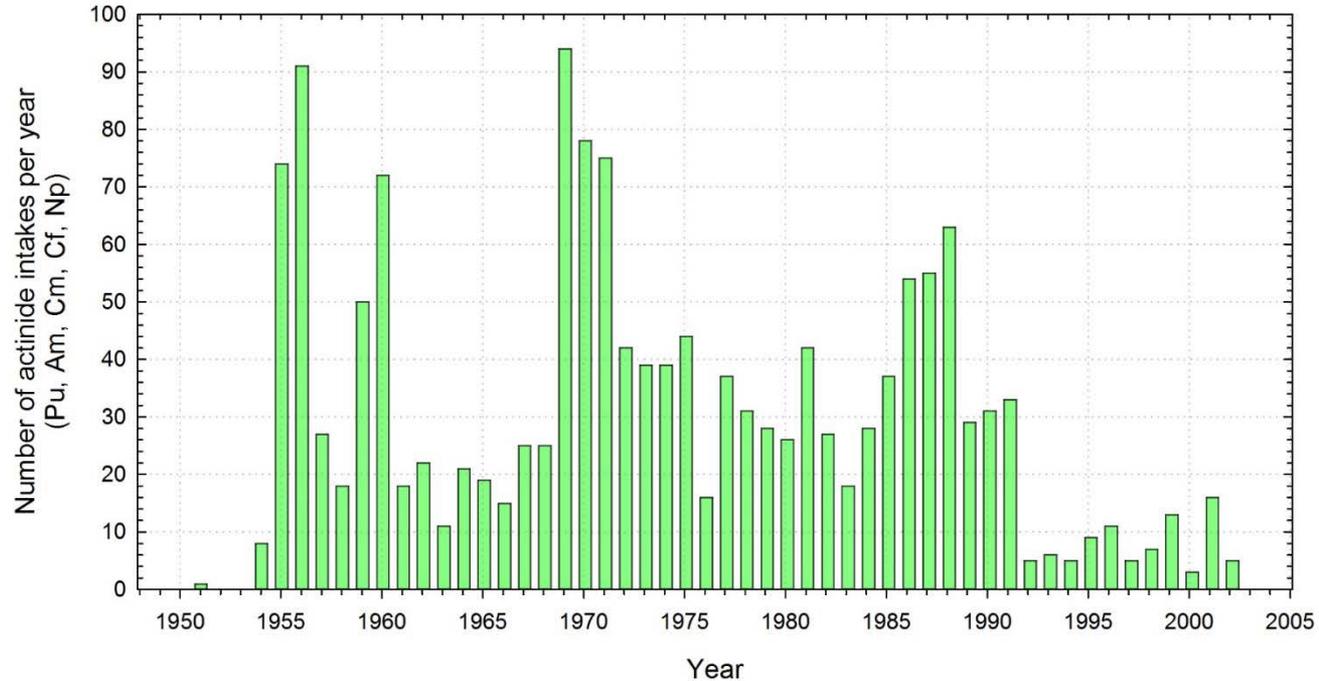
- There is no evidence that subcontractors were primarily or only monitored via job-specific bioassay that would bias a co-worker model.
- Even if a larger percentage of subcontractors used the job-specific bioassay compared to WSRC employees (CTWs or Operations), a **larger** fraction of subcontractor Construction Trades Workers (CTWs) were monitored via routine bioassay (Job Plan Analysis, SC&A Re-analysis, NOCTS analysis).
- Recall NOCTS data used in dose reconstructions indicates that over 90% of the subcontractors have some form of internal monitoring between 1991 and 1997
- The 10CFR830 violation effects both CTWs (WSRC and Subcontractor) as well as operations workers (WSRC)

Implications for Dose Reconstruction under EEOICPA

- Significant workplace and individual monitoring information through the surveillance to support that there was no internal dose that went undetected.

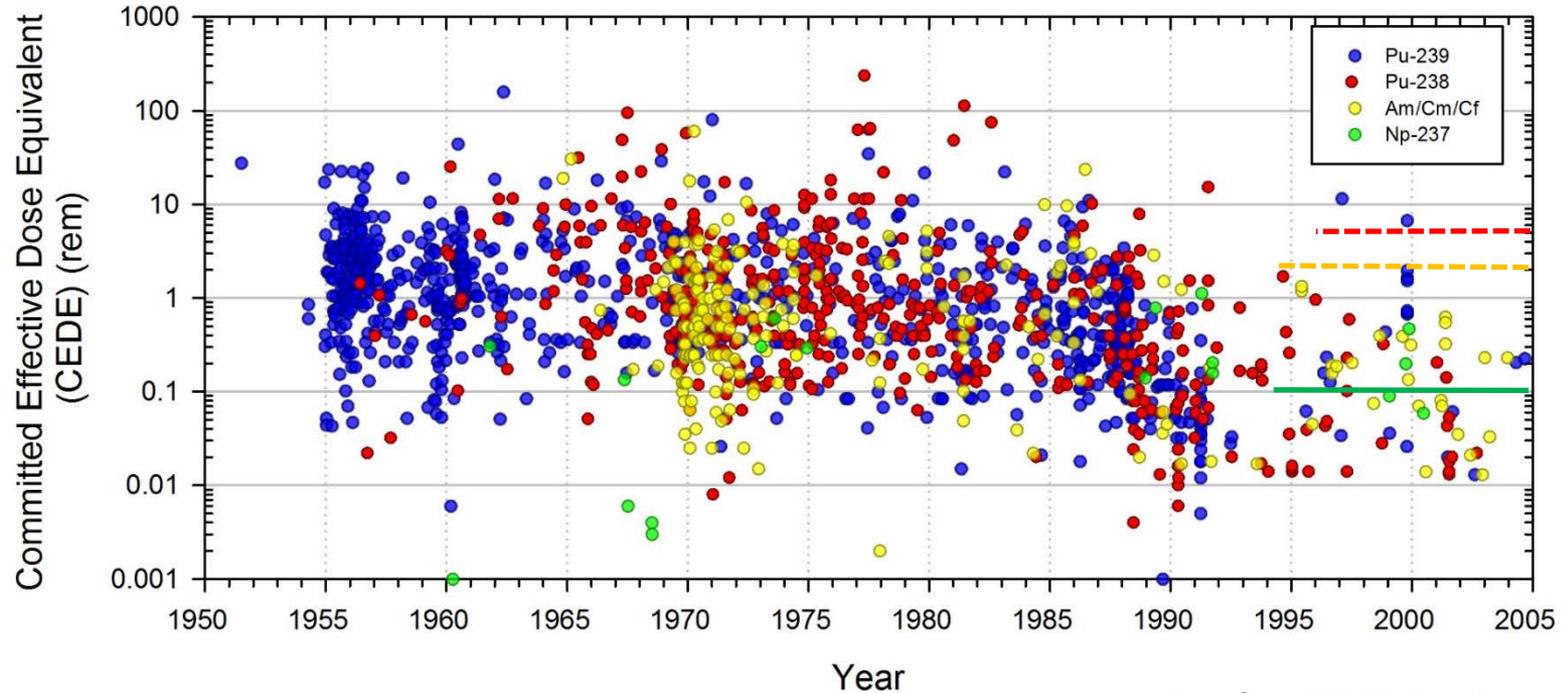


Actinide intakes per year



Data from SRDB# 168368

History of SRS Internal Exposures



Data from SRDB# 168368

Conclusion

- NIOSH concludes that dose reconstruction is feasible and sufficiently accurate through the use of a co-worker model for those that did not leave a bioassay sample or have any internal monitoring.
 - Individual data can be used to estimate personal dose for missing data in previous years without needing a co-worker model.
 - For those with no internal monitoring data, NIOSH believes that the monitoring data from the 339 internally monitored subcontractor coworkers could be used to bound the dose to the 32 (8.6%) unmonitored subcontractor workers

Open Workgroup Issues to Resolve

1. *Workers who performed work at SRS under RWP-required job-specific bioassays have substantially incomplete monitoring data – intakes may have occurred and missed for transient subcontractors.*
 - 1a) NIOSH Evaluate to determine if there is a subset of the SRS workforce (operations, WSRC Construction, Subcontractor Construction) that predominately uses job-specific bioassay? Potential Needs: Facility Evaluation Board reports (FEB). SRS is working on locating the reports requested in September 2017 (initial funding issues resolved in October)
 - 1b) NIOSH evaluate transient subcontractors bioassay data in NOCTS and compare to routine subcontractors bioassay data for a potential bias. – Active Evaluation underway

Open Workgroup Issues to Resolve

2. *RWP jobs often differed by source terms and potential exposure from routine work; routine monitoring data should not be used as a surrogate for missing RWP monitoring data.*

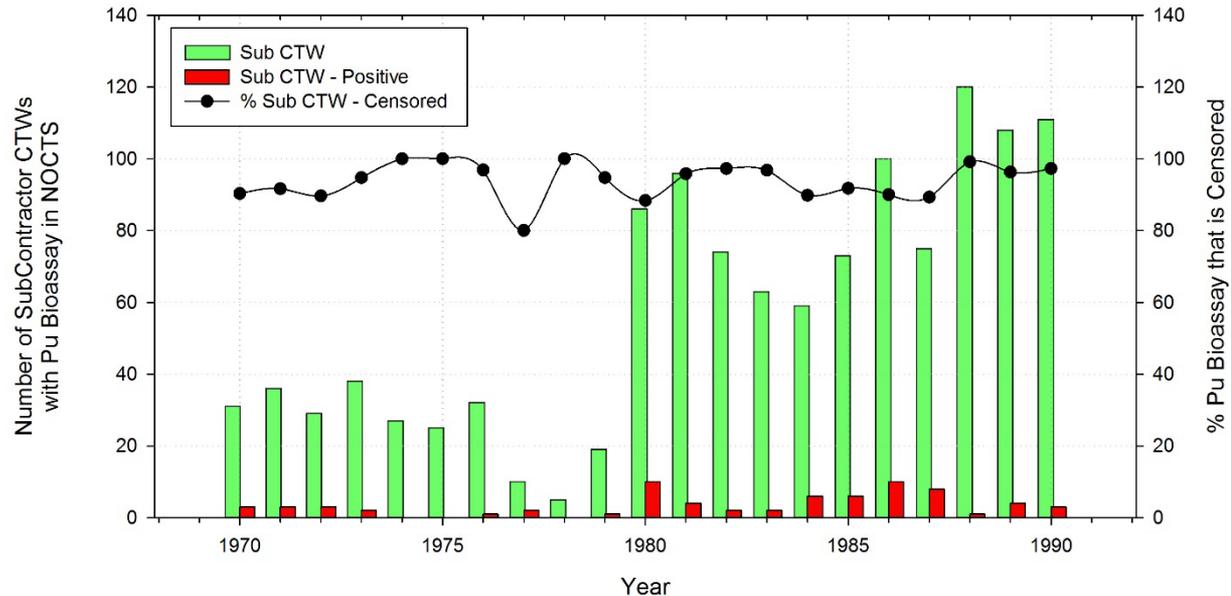
- In abeyance
Issue to be further discussed

Open Workgroup Issues to Resolve

3. *Based on NIOSH comparisons of maximum possible 95th percentile dose distributions of SRS plutonium bioassay for DuPont CTWs and subcontractor CTWs, results indicate a number of years (in 1970s-1980s) where subcontractor Pu bioassays are 2-5 times higher than DuPont CTWs. This corresponds with interviews with subcontractor CTWs who indicate that they were called in for contaminated work to save the exposure of onsite CTWs.*
 - NIOSH will provide a more comprehensive analysis of these data, which will include consideration of how NIOSH develops inhalation intake models under EEOICPA.

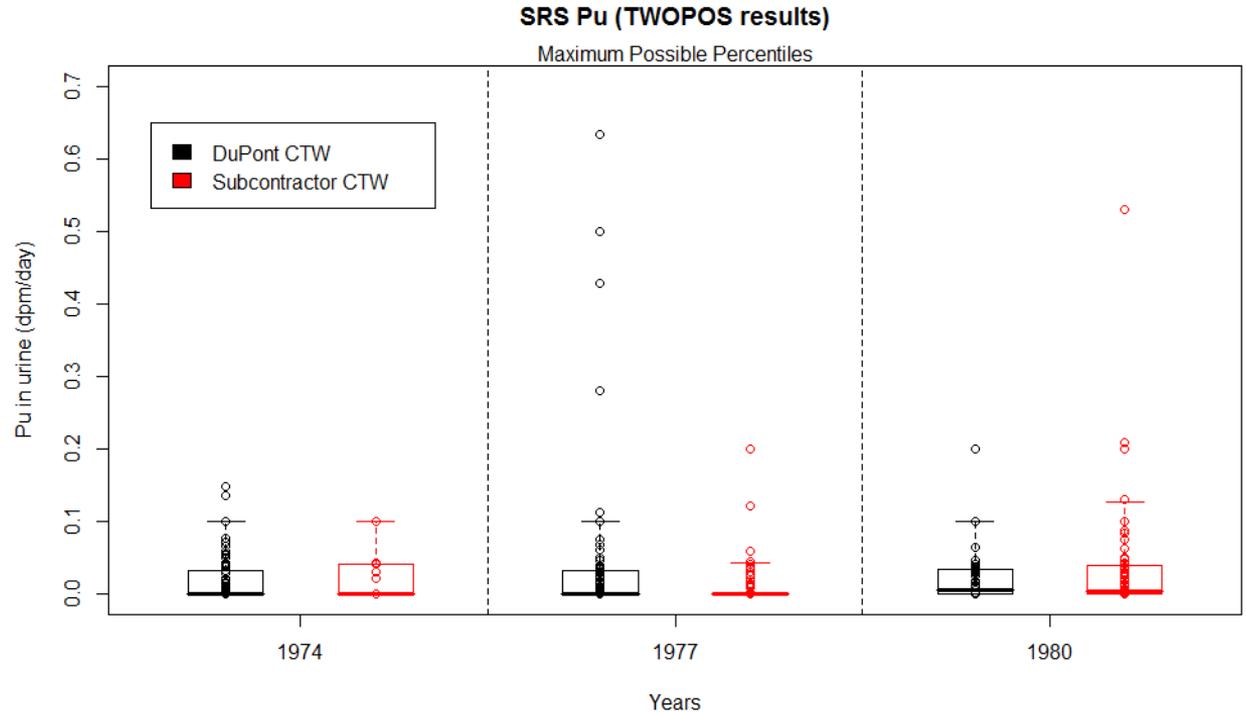
DuPont CTW vs. Subcontractor CTW - Bias

- Difficulty comparing DuPont CTWs vs Subcontractor CTWs is that the majority of the data is below the censoring level of 0.1 dpm/day (non-detects)



DuPont CTW vs. Subcontractor CTW - Bias

- Extracted uncensored data from the Pu bioassay logbooks for comparison



Open Workgroup Issues to Resolve

5. *In terms of SRS coworker model development, NOCTS claimant dataset likely inadequate for dose reconstruction with sufficient accuracy for SRS construction workers. OTIB-0075 issues identified in 2010; stratification tests yet to be performed.*
 - Since this is primarily a co-worker issue regarding ORAUT-OTIB-0081, which already stratifies the workforce into Operations versus Construction Trades Workers (CTWs), SC&A to review/reconsider comment and provide feedback to the SRS Workgroup.

Open Workgroup Issues to Resolve

6. *Workers in some SRS facilities were apparently unmonitored for Am-241 due to inadequate source term characterization; other radionuclides may have been missed due to inadequate facility characterization process.*
 - SC&A to provide report to workgroup detailing concern such that the workgroup and NIOSH can review for potential impact on monitoring methods.

Open Workgroup Issues to Resolve

7. *Timeframe of monitoring gap unclear before 1997, as is worker cohort affected by lack of job-specific bioassays.*
 - Due to limited assessment data in 1995 and 1997, NIOSH requested Facility Evaluation Board reports in 1994, 1995, 1996, and 1997 in September 2017. Upon receipt of these reports, NIOSH will evaluate the extent of this issue.