Response to SC&A's Evaluation of Savannah River Site Subcontractor Bioassay Data Completeness

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Meeting of the Savannah River Site Workgroup of the Advisory Board on Radiation and Worker Health (ABRWH)

November 2017

Overview

- SC&A Subcontractor Analysis
- NIOSH Findings / Response
  - 30 and 90 day criteria
  - Reanalysis of SC&A data using annual criteria for non-tritium bioassay
- Evaluation of the Notice of Violation (NOV)
  - Why 10CFR830 Procedural violation and not 10CFR835 Radiological Control Violation?

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
    - At the 30,000 ft level very similar to NIOSH's findings
  - 90 day post RWP (244/306) – 80% compliance rate

- When RWP specifically indicated Bioassay
  - 30 day post RWP (140/197) – 71% compliance rate
    - At the 30,000 ft level very similar to NIOSH's findings
  - 90 day post RWP (166/197) – 84% compliance rate

NIOSH Findings of SC&A Report

- Use of 30 day and 90 day criteria for bioassay
  - 30 day is appropriate for tritium
    - 100 mrem tritium dose detectable 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.
- *Finding 1: Bioassay Data should have been separated into tritium and non-tritium and appropriate time intervals used for evaluation*

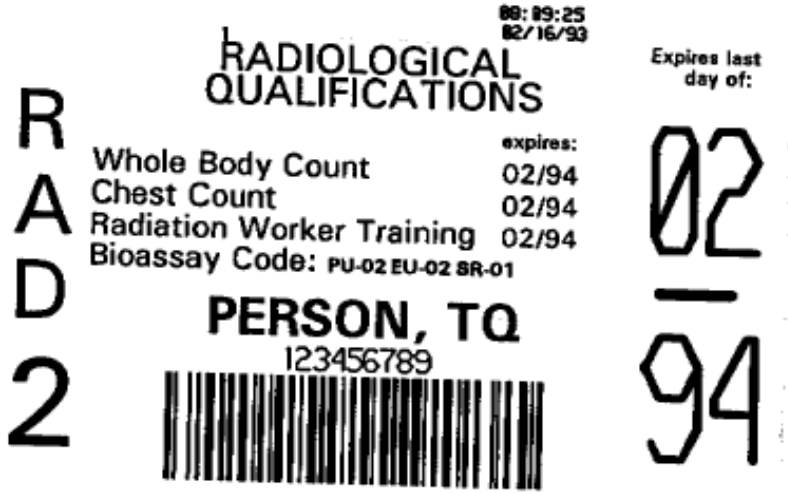
1st Misconception about Radiological Work Control and Monitoring at SRS

- If the worker was only required to leave a non-tritium sample once or twice a year such as plutonium, enriched uranium, strontium, then the 30 and 90 day criteria is not appropriate.

- 1990s Radiological work control
  - Worker attends radiological training (Rad Worker II)
  - Worker signs into RWP
  - Worker checks their Bioassay Codes on the Radiological Qualifications Card against the RWP requirements

Radiological Qualification Card (1994)

- Rad Worker II
- Whole Body count
- Chest Count (actinides)
- Bioassay Codes
  - Pu-02 (Plutonium 2/yr)
  - EU-02 (Enriched Uranium, (2/yr)
  - Sr-90 (Strontium-90, 1/yr)



SRDB# 167850

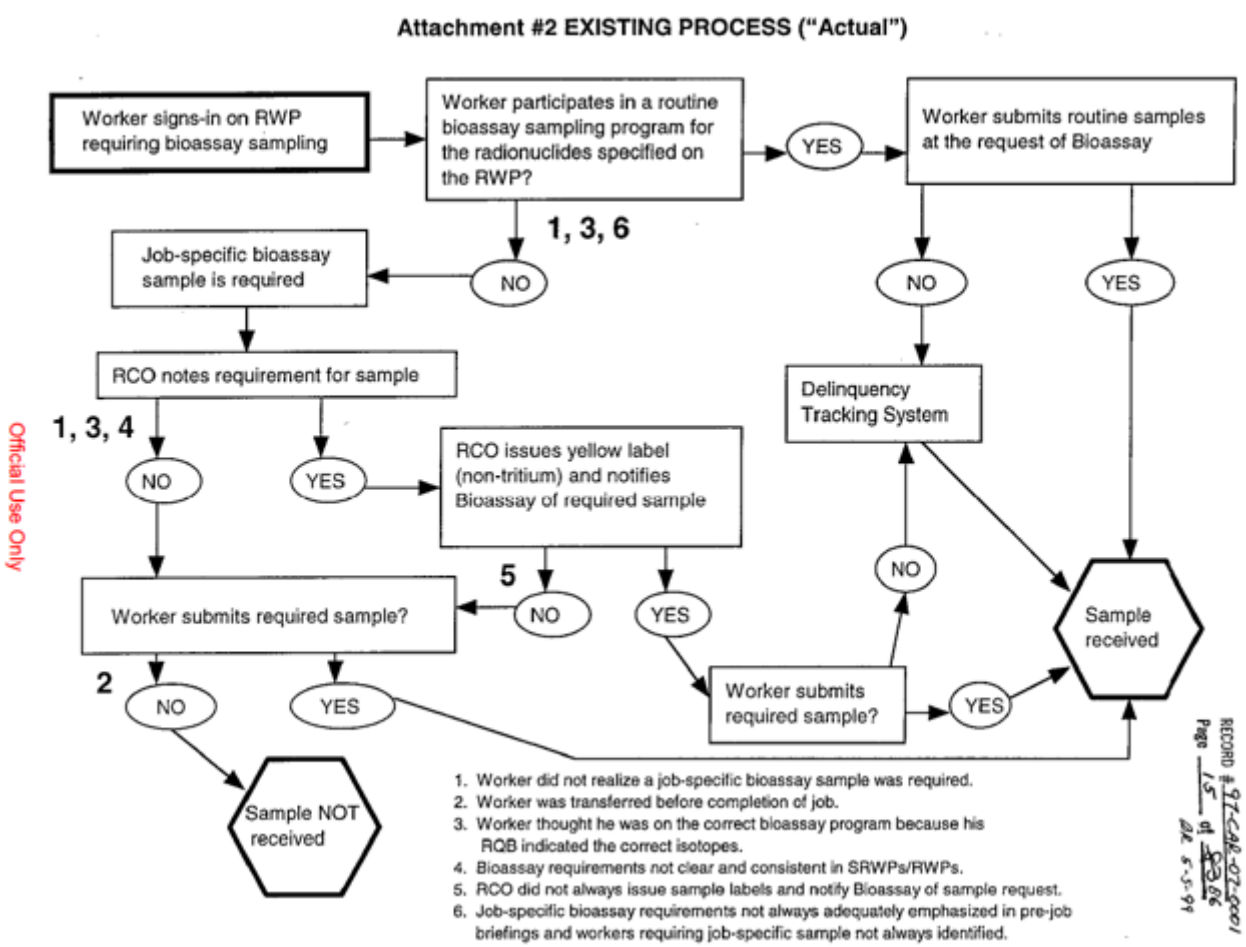
2nd Misconception about Subcontractor Monitoring

- Job-Specific bioassay was **NOT** the only manner in which subcontractor construction trades workers were monitored.
- A significant fraction were monitored via routine or prescheduled bioassay based on their Radiological Qualification Card
  - NIOSH will demonstrate this during our presentation on Subcontractor monitoring data in NOCTS

Actual Subcontractor Monitoring

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

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



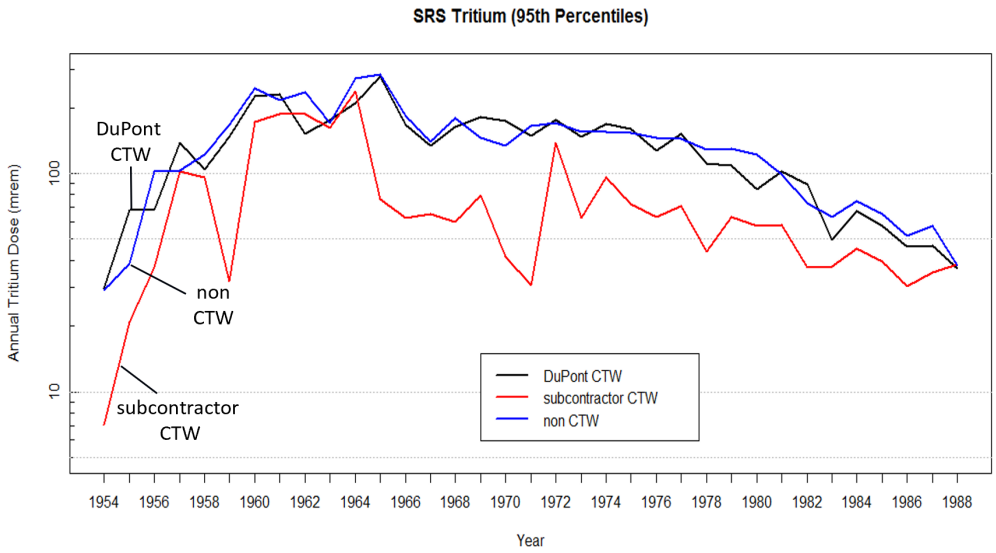
SRDB# 167757

NIOSH Reevaluation of SC&A Report Data for Tritium (1 of 2)

- SC&A did not break out tritium in their analysis
- NIOSH Reevaluation
  - 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 Reevaluation of SC&A Report Data for Tritium (2 of 2)

- Since 1972 the 95th percentile subcontractor tritium dose has been less than 100 mrem with a downward trend
- Since 1980 the DuPont CTWs 95th percentile dose has been less than 100 mrem again with a downward trend.
- Conclusion tritium monitoring of subcontractors is not a dose reconstruction problem at SRS.



NIOSH Reevaluation of SC&A Report Data for Non-Tritium (1 of 2)

- Again misconceptions about the actual bioassay monitoring practice led SCA to exclude a significant number of samples from their analysis.
- Prescheduled non-tritium bioassay was generally conducted semi-annual or annually (on or near birthdate).
  - SC&A only identified 62 non-tritium bioassay
  - Limited number primarily due to the exclusion of samples outside the 30 and 90 day time window.

NIOSH Reevaluation of SC&A Report Data for Non-Tritium (2 of 2)

- NIOSH Reevaluation 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

SC&A Concludes - Incomplete 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".*
  - 90.8% monitoring of subcontractors for tritium
  - 87.3% monitoring of subcontractors for non-tritium

Notice of Violation

- Excerpt from SC&A Report
  In the course of its review, SC&A also established that a chronic history of wide noncompliance with job-specific bioassay requirements existed at SRS, resulting in a Departmental Notice of Violation being levied in 1998. (page 6)

- Implication is that there is inadequate workplace and worker monitoring for radiological hazards at SRS and therefor NIOSH cannot bound the dose with sufficient accuracy.
  - Further implication is that this effects primarily subcontractors

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 working to compile the information now.

DOE Notice of Violation – 10 CFR830.120

- 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%).

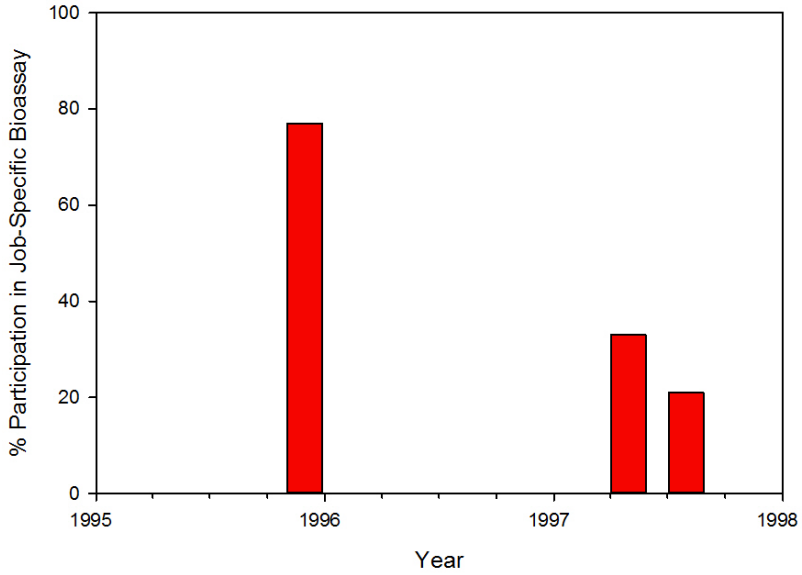
DOE Notice of Violation – 10 CFR 830.120(c)(1)(iii)

- 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

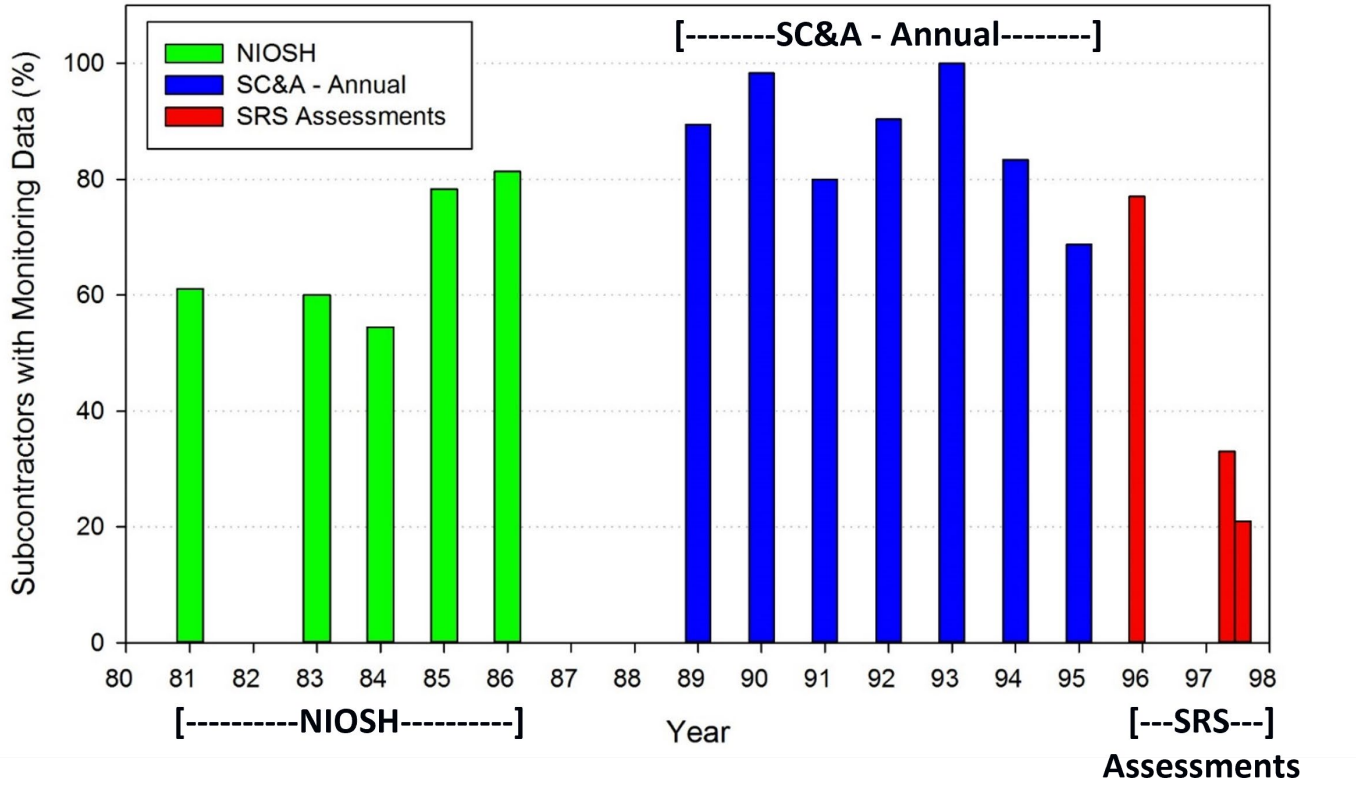
SRDB# 167497

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



NIOSH Evaluation and SC&A Evaluation Data



Notice of Violation – NIOSH Evaluation

- *Why was the a violation of 10CFR830.120 levied (procedural violation) and **NOT** a violation of 10CFR835 Radiological Control and Monitoring?*

- If people were not being monitored properly that is a violation of
  - 10CFR835.401(a)(1) Monitoring of the Workplace
  - 10CFR835.402(c)(1) Individual Monitoring

SRDB# 167851

10CFR835.401(a,b) Monitoring of Workplace

- (a) Monitoring of individuals and areas shall be performed to:
  (1) Demonstrate compliance with the regulations in this part;
  (2) Document radiological conditions in the workplace;
  (3) Detect changes in radiological conditions;
  (4) Detect the gradual buildup of radioactive material in the workplace;
  (5) Verify the effectiveness of engineering and process controls in containing radioactive material and reducing radiation exposure.
- (b) Area monitoring in the workplace shall be routinely performed, as necessary, to identify and control potential sources of personnel exposure to radiation and/or radioactive material.

10CFR835 (1997)

10CFR835.402(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)

During Enforcement Conference on July 28, 1998

- WSRC described the purpose of its bioassay sampling program

- WSRC stated it had a formal, no intake policy for radionuclides, other than tritium, and that along with its formalized workplace indicators program, including air sampling and contamination surveys, were the primary means of determining whether a worker required bioassay sampling outside of the routine bioassay program. For these cases, special bioassay sampling was performed.

SRDB# 167497

Radiological Control - Defense in Depth

- SRS used a Defense in Depth approach to Radiological control with the intention to prevent non-tritium intakes
  - Policy (zero intake policy)
  - Engineered Controls
  - Procedural Controls
  - Personnel Protective Equipment (PPE)
  - Surveillance

SRDB# 167851

Surveillance

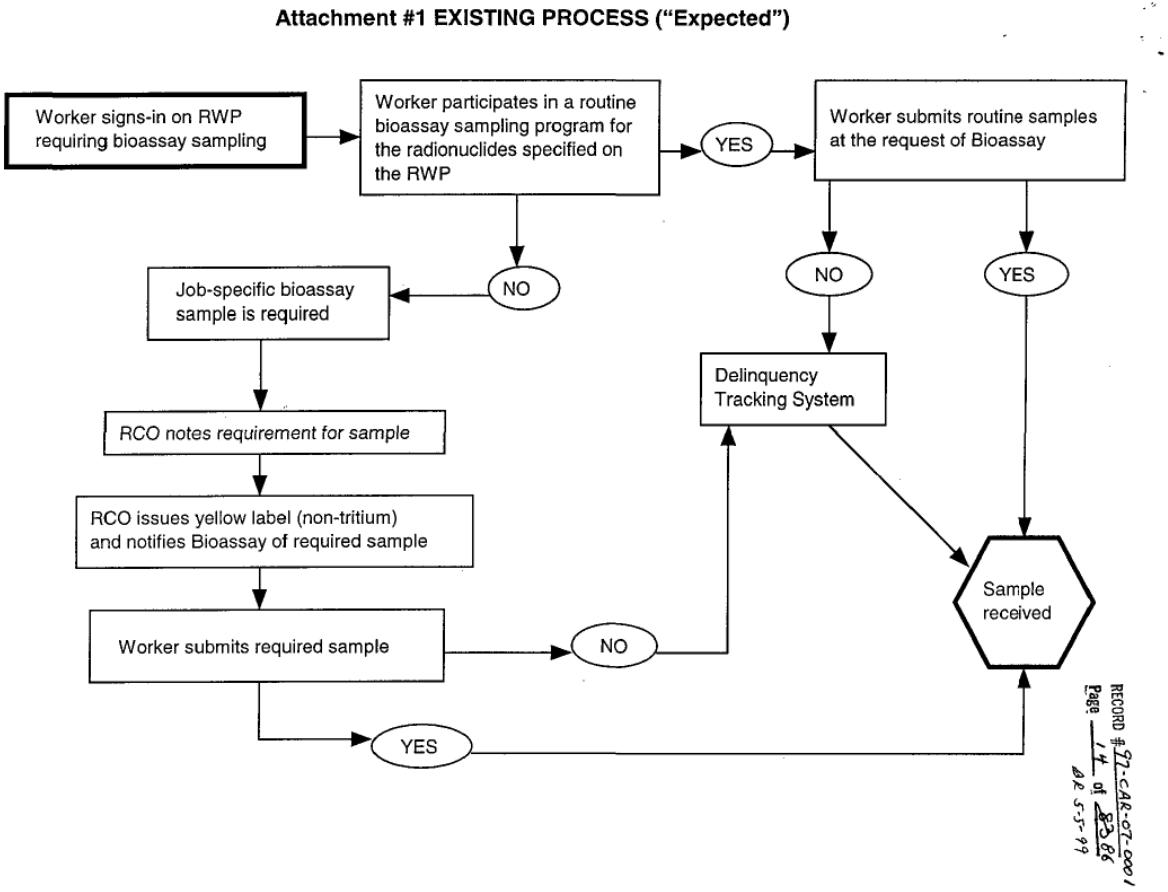
- Used to verify effectiveness of engineered controls, procedural controls and Personal Protective Equipment (PPE)
  - Air Monitoring
  - Facility Contamination Surveys
  - Personnel Contamination Surveys
  - Routine Bioassay

SRDB# 167851

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)

“Expected” Monitoring



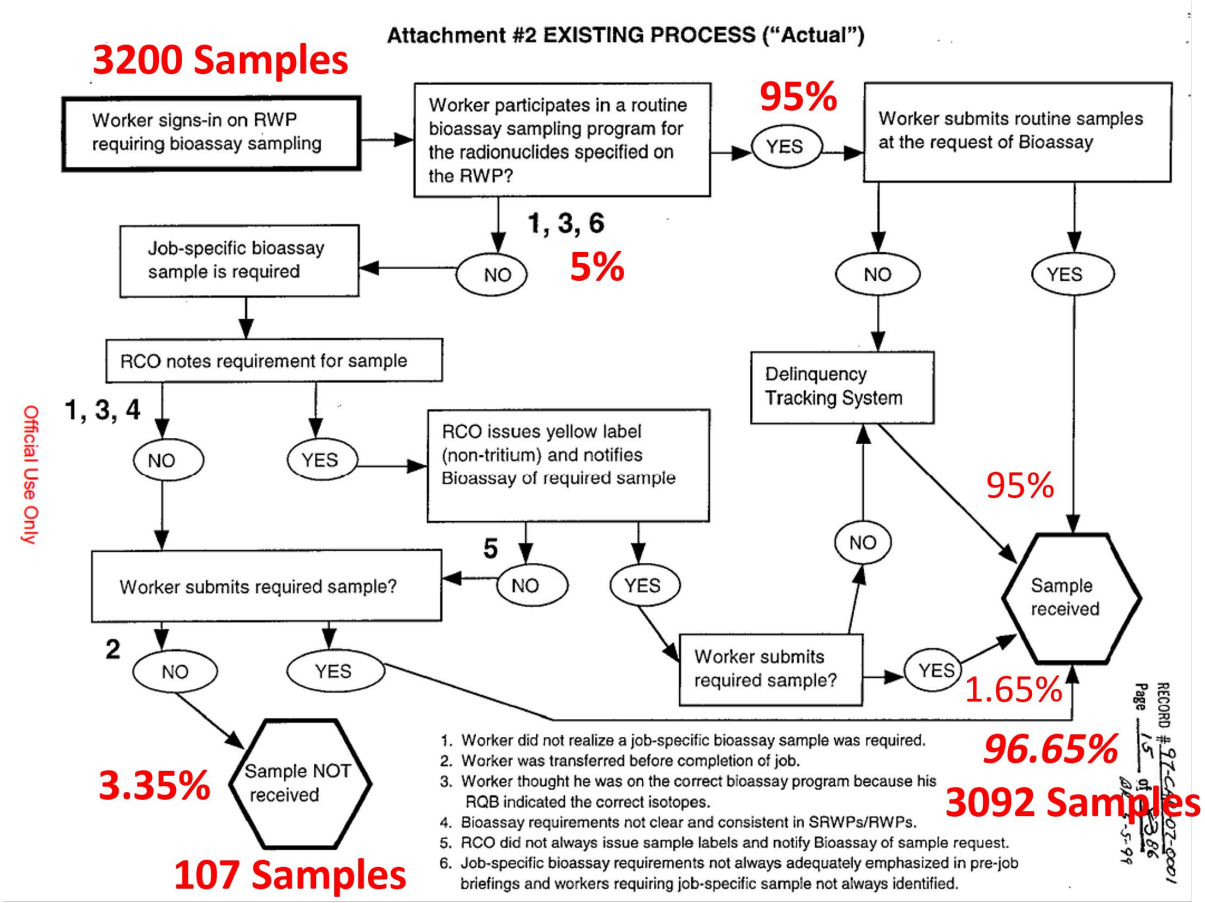
SRDB# 167757

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**



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 and required follow-up

	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 (1 of 5)

- 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 used for surveillance to confirm adequacy of workplace monitoring and controls.
  - Routine or prescheduled bioassay monitoring was the primary method of 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 (2 of 5)

- *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.****" (SRDB 167497)*

Implications for Dose Reconstruction under EEOICPA (3 of 5)

- With the follow-up sampling of the 256 workers conducted by the site, there is **no** missing bioassay in 1997 regardless of the initial 66% 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.

- 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 (4 of 5)

- SC&A has not demonstrated that subcontractors were primarily or only monitored via job-specific bioassay that would bias a co-worker model. The violation effects both CTWs (WSRC and Subcontractor) as well as operations workers (WSRC)

- 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 as we will demonstrate in our next presentation on subcontractor monitoring data in NOCTS.

Implications for Dose Reconstruction under EEOICPA (5 of 5)

- There are ***NO*** evidence of a workplace exposure nor an indication that there was a missed intake of radionuclides at the Savannah River Site.

- Significant workplace and individual monitoring information through the surveillance including over 10,000 bioassay samples in 1997 to support that there was no internal dose that went undetected.

- NIOSH therefore concludes that dose reconstruction is feasible and sufficiently accurate through the use of a co-worker model.