



Evaluation of Bioassay Data for Subcontracted Construction Trade Workers at the Savannah River Site

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Overview

- Background
- Work Permit Sampling Plan
- Evaluation of Subcontractor Bioassay Monitoring
 - Modern Era (1990-1998)
 - Late Dupont Era (1980-1989)
 - Mid Dupont Era (1972-1979)
- Conclusions
- Evaluation Timeline

Subcontractor monitoring evaluation

Summary of Issue and Monitoring Methodology

Coworker model use

- NIOSH develops coworker models because we recognize that some workers were not monitored
- For a coworker model to be valid a representative sample is all that is needed
- If all exposed workers were monitored (100%) for every radionuclide, there would not be a need for a coworker model

Issue: Incomplete Subcontractor Data for co-worker

- From December 2017 ABRWH Meeting
 - *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). [emphasis added]*
 - 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*).

SRS 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 and Job Specific Bioassay*

Routine and Job Specific Bioassay

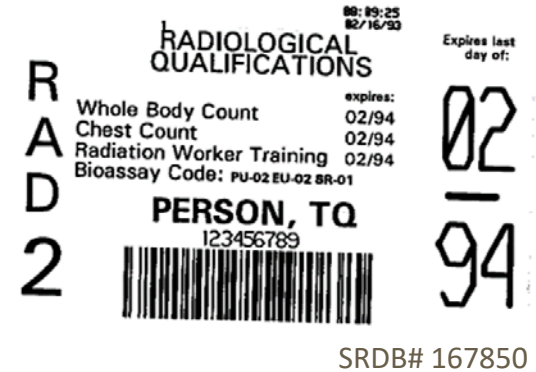
- No practical difference between routine and Job Specific Bioassay
 - Used to a check to verify effectiveness of procedural and engineered controls
 - Trigger for-cause (Special) bioassay programs
 - Requested from workers who have a *reasonable potential for intakes* but who SRS was confident did not 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)

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 Radiation Work Permit (RWP) requirements or area for bioassay
- Worker conducts their work
- Worker leaves bioassay based on either their routine schedule or job-specific requirement if the worker is not on a routine schedule for the radionuclide of interest (SAME WORK)



Bioassay Codes

Pu-02 (Plutonium 2/yr)

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

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

Routine vs. Job-Specific Bioassay

- Most workers (95%) were on routine bioassay
- SC&A postulated that subcontractors were primarily on job-specific bioassay

*Question of how “complete is complete enough” for coworker development can only be answered in context of coworker guidelines and stratification assumptions that have been validated – they guide what datasets can be legitimately applied. **However, 79% incompleteness strains credulity.** [Emphasis added] (SCA Presentation November 14, 2017)*

- SCA implied that only 21% of the subcontractors were monitored

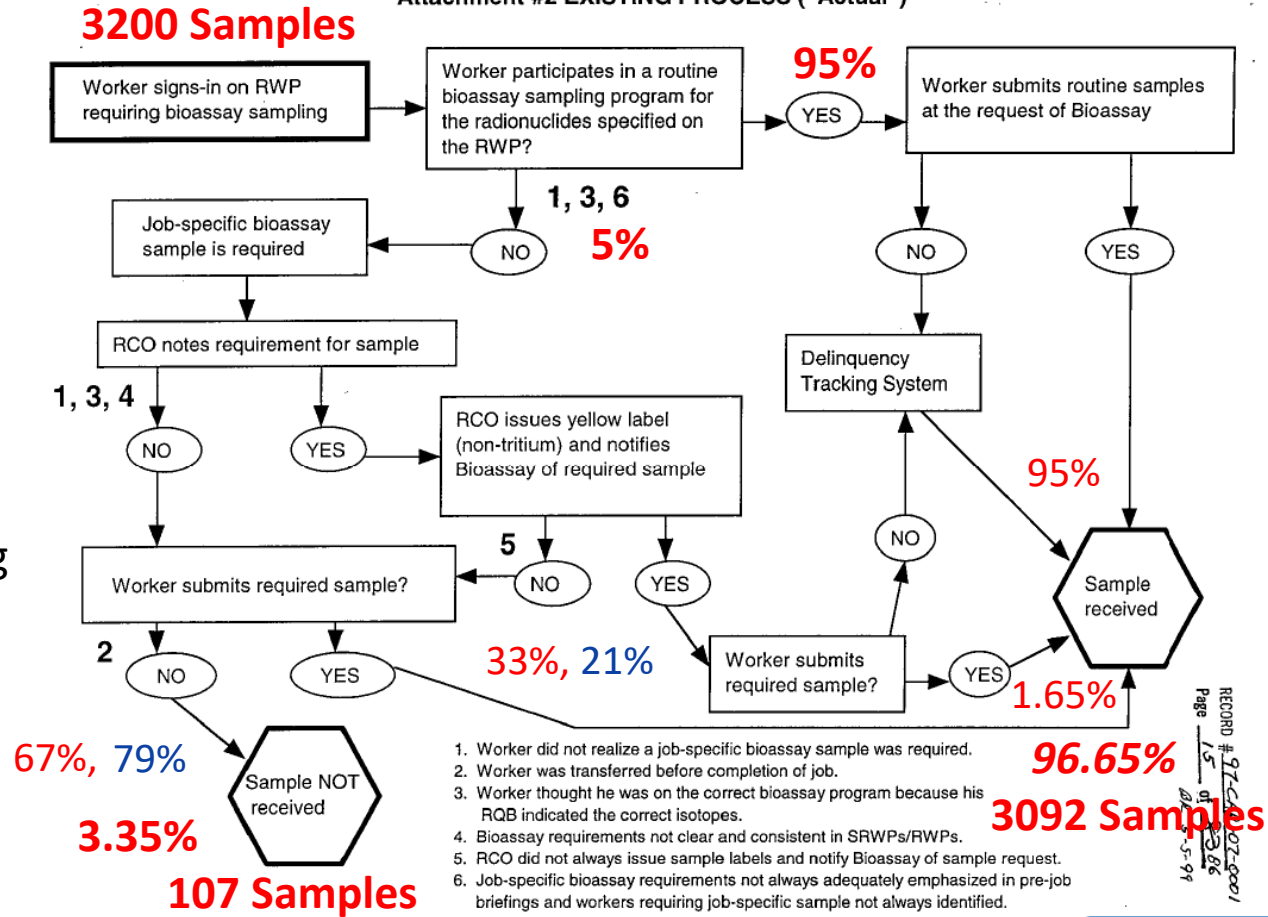
Subcontractor Monitoring

SRS Limited assessment of 3200 bioassay requirements (all workers)

95% on Routine monitoring
5% required Job Specific monitoring

33% compliance on Job specific bioassay

Attachment #2 EXISTING PROCESS ("Actual")



SRDB# 167757



RECORD # 97-CA-07-0001
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Unanswered Questions

- What fraction of Subcontractor Construction Trades Workers were monitored?
 - *Were subcontractors primarily monitored via job specific bioassay and therefore only a few subcontractors were actually monitored (i.e. SC&A's comment indicates only 21% monitored)?*
 - *Did the subcontractor monitoring change over time, area, craft?*
 - *Did the unmonitored subcontractor CTWs work side by side with monitored subcontractor CTW workers?*
 - *Were subcontractors monitored for the correct radionuclides?*

Subcontractor monitoring evaluation

Modern era 1990-1998

3 Goals of the Subcontractor Evaluation

1. Determine the percentage of subcontractor Construction Trades Workers (subCTWs) monitored by year
2. Determine whether unmonitored subCTWs were represented by a monitored subCTW in the same radiological environment (same RWP) at the same time
3. Determine whether subCTWs were monitored for the radionuclides of concern given the radiological environment on the RWP

Developed RWP Sampling Plan

- Randomly select subcontractor radiation workers from the various areas at the Savannah River Site (SRS), such that an evaluation of monitored and unmonitored workers can be conducted
 - First step was to define the Sampling Frame
 - Focused on actinide exposures (Pu, U, Am, Np)
 - Excluded reactor areas (C,K,L,P,R) - low dose tritium
 - Excluded Standing Radiation Work Permits (SRWPs) considered routine work

RWP Sample Frame (estimated pages)

Table 2-2 Example

Area	1990	1991	1992	1993	1994	1995	1996	1997	1998
A	0	601	0	1802	2926	0	0	0	0
E	0	0	75	0	55	0	0	3	0
F	15	3168	3819	2288	2415	1475	2220	6878	6785
H	0	751	4165	6685	1292	4101	2645	0	0
M	0	0	884	626	0	0	0	0	0
Z	0	0	0	457	525	0	0	0	0
Totals	15	4520	8943	11858	7213	5576	4865	6881	6785

RWP Sample Frame (Folders containing RWPs w/subCTWs)

Table 2-5 Example

Area	1990	1991	1992	1993	1994	1995	1996	1997	1998	Total
A	0	4	0	1	1	0	0	0	0	6
E	0	0	1	4	1	0	0	1	0	7
F	1	5	19	12	15	7	9	27	34	129
H	0	5	19	36	10	14	9	0	0	93
M	0	0	3	3	0	0	0	0	0	6
Z	0	0	0	2	2	0	0	0	0	4
Totals	1	14	42	58	29	21	18	28	34	245

RWP Sample Frame (Folders containing RWPs w/subCTWs)

Table 2-8 Example (RWP-Months)

Sampling scheme	A	E	F	H	M	Z	Total
Proportional	2	2	42	30	1	1	78
Semi-proportional	15	10	30	30	10	10	105
1.5 x semiproportional	23	15	45	45	15	15	158

- Goal of semi-proportional was to better represent all areas while keeping the sample size semi-proportional to the number of folders in each area.
- RWP Sampling (Folder – RWP - Month)

SubCTW Folder Sampling

	1990	1991	1992	1993	1994	1995	1996	1997	1998	Total
A	0	4	0	1	1	0	0	0	0	6
E	0	0	1	4	1	0	0	1	0	7
F	1	5	19	12	15	7	9	27	34	129
H	0	5	19	36	10	14	9	0	0	93
M	0	0	3	3	0	0	0	0	0	6
Z	0	0	0	2	2	0	0	0	0	4
Total	1	14	42	58	29	21	18	28	34	245

Sample 32

RWP-1 RWP-2 RWP-3 RWP-4 RWP-5 **RWP-6**

March **April**

1 of 2 unique CTWs monitored

The diagram illustrates the sampling process. A red arrow points from the cell containing '19' in the 1992 column and 'F' row of the table to a box labeled 'Sample 32'. Another red arrow points from 'Sample 32' to the 'RWP-6' box in the row of RWP categories. A third red arrow points from 'RWP-6' to the 'April' box in the row of months. A final red arrow points from 'April' to the '1 of 2 unique CTWs monitored' box. A horizontal red line is drawn across the middle of the diagram, separating the table from the RWP and month boxes.

Sampling Procedure

- Sampled folders in boxes until the minimum number of months (158) and the minimum number of subCTWs (766) were satisfied.
- In total 662 subCTWs RWP-Month evaluations
 - 429 individual CTWs making 662 entries
 - 146 RWPs were captured and evaluated
- Why did we not get 766 subCTWs?
 - Not all RWPs captured required bioassay monitoring

Co-worker Matching Criteria - Implementation Guide

*The minimum number of samples should, of course, be considered considering the number of workers potentially exposed to the airborne source-term. For example, the number of samples necessary to be representative of the exposures at a uranium foundry, where airborne activity is generally widespread, will be greater than the number required of a small glove box operation where six workers were involved in the manipulation of plutonium parts. **In the latter situation, it may be that samples for three out of six workers could be used to bound exposures for the three who were not monitored. [emphasis added]***

Criteria for Matching Co-workers

- Consider an RWP of interest as a small work activity
- **Evaluation criteria was same RWP on the same day and time**
 - However, time is not exact (morning or afternoon)
- We did not match on craft
 - Why? Exposure environment is critical component
 - Exposure environment can vary depending on RWP work being conducted... Context matters...
 - Crafts may have similar or different exposure potential

Co-worker Matching Example #1 from Table 4-7

- Location: 241H (Tank Farms)
- Work Description: Deconning V2 riser for hut tear down

SID	CTW	Craft	Date	Time In	Time Out	Pu Monitoring	Sr-FP
4	CTW-128	Laborer	3/24/1992	8:16	11:00	Yes	Yes
4	CTW-268	Sheetmetal	3/24/1992	8:30	11:00	No	Yes
4	CTW-449	Laborer	3/24/1992	8:30	11:00	Yes	Yes
4	CTW-466	Carpenter	3/24/1992	8:15	11:00	Yes	Yes

Matching Co-workers (craft and all radionuclides on RWP)

- We believe this is all similar work that meets the criteria
 - craft matching is not necessary
- We do not believe it is correct to say this worker was **not monitored** because the worker was not monitored for all radionuclides on RWP
 - Worker was not monitored for plutonium
 - Dose reconstruction can be conducted for strontium using worker's personal bioassay
- Co-worker model can be used to estimate plutonium
 - Similar work in same radiological environment

Monitoring Evaluations Conducted

- Monitoring percentage for radionuclides of concern
 - Plutonium
 - Strontium
 - Uranium
 - Americium
 - Neptunium
- Evaluated by Year, Area, and Craft
- Considered effective monitoring based on matched co-workers for specific radionuclides

Subcontractor Monitoring Evaluation - Plutonium

- 644 subcontractor CTWs required Plutonium monitoring from 140 RWPs
- 567 (88%) subcontractors monitored for plutonium
 - 548 monitored via Plutonium urinalysis
 - 19 monitored via *in vivo* chest count
 - Mean number of days from RWP to bioassay 159 days
 - 501 within a year, another 39 within 2 years (540)
 - Some terminated workers were monitored upon return > 2 years

Plutonium Monitoring Evaluation - Year

Year	Bioassay Required	No of RWP's	SubCTW monitored	% with bioassay	SubCTWs matched to Coworker	Effective % monitored
1991	82	17	78	95%	3	99%
1992	88	23	85	97%	3	100%
1993	173	27	154	89%	11	95%
1994	140	32	104	74%	20	89%
1995	57	15	52	91%	5	100%
1996	24	7	20	83%	0	83%
1997	55	9	54	98%	1	100%
1998	25	10	20	80%	4	96%
Total	644	140	567	88%	47	95%

Plutonium Monitoring Evaluation - Craft

Craft	Bioassay Required	# of RWPs	SubCTW monitored	% with bioassay	SubCTWs matched to Coworker	Effective monitored
Boilermaker	27	12	24	89%	2	96%
Carpenter	79	33	71	90%	7	99%
Electrician	56	24	49	88%	2	91%
Insulator	17	9	16	94%	0	94%
Iron/Sheetmetal	137	33	122	89%	12	98%
Laborer	174	70	147	84%	14	93%
Millwright	15	6	13	87%	2	100%
Painter	22	12	17	77%	4	95%
Pipefitter	102	42	94	92%	4	96%
Other	15	8	14	93%	0	93%
Totals	644		567	88%	47	95%

Plutonium Monitoring Evaluation - Area

Area	Bioassay Required	No of RWP's	SubCTW monitored	% with bioassay	SubCTWs matched to Coworker	Effective % monitored
A	112	21	101	90%	6	96%
F	200	49	177	89%	14	96%
H	230	50	218	95%	8	98%
E	23	10	17	74%	3	87%
Z	79	10	54	68%	16	89%
Totals	644	140	567	88%	47	95%

Plutonium Monitoring Evaluation

- No significant difference in plutonium monitoring by
 - Year
 - Craft
 - Area

- Conducted this evaluation for all radionuclides of interest

Subcontractor Bioassay Monitoring 1990-1998

Radionuclide	Bioassay required	SubCTWs monitored	% with bioassay	SubCTWs matched to Coworker with bioassay	% monitored or matched with a coworker
Plutonium	644	567	88%	47	95%
Strontium	429	414	97%	12	99%
Uranium	225	199	88%	17	96%
Americium	180	131	73%	25	87%
Neptunium	91	63	69%	13	84%
Total	1569	1374	88%	114	95%

Most Subcontractor CTWs Were Monitored

- Subcontractor CTWs are considered an “at Risk” or vulnerable population
 - Expected to be the worst of the 3 populations
 - Operations workers
 - Prime construction trades workers
 - Subcontractor construction trades workers
- Fraction of subcontractor workers needing a co-worker model to supplement bioassay is rather small on the order of less than 15%

Subcontractor Monitoring Percentage

- “At least one bioassay” – Global view (30,000 ft level)
- Of the 662 subcontractor Construction Trades Workers (subCTWs) entries, 633 had one or more required bioassay results
 - Weighted by area strata the monitoring percentage
 - Point estimate 95.13% (*95th CI: 87.18% - 98.84%*)
- Bottomline: Most subcontractors were monitored for internal exposures and have bioassay data between 1990 and 1998

Subcontractor Monitoring Percentage – cont.

- 29 subCTWs (4.4%) did not have any monitoring data
 - 19 unmonitored subCTWs (65.5% of unmonitored) were directly represented by co-workers with bioassay
 - Only 10 subCTWs (34.5% of unmonitored) were not represented by a co-worker
 - 5 of the 10 either waived the bioassay requested or Health Physics determined bioassay was not required
 - 5 of 662 (<1%) not directly represented by a co-worker

Subcontractor Bioassay Monitoring 1990-1998

Radionuclide	Bioassay required	SubCTWs monitored	% with bioassay	SubCTWs matched to Coworker with bioassay	% monitored or matched with a coworker
Plutonium	644	567	88%	47	95%
Strontium	429	414	97%	12	99%
Uranium	225	199	88%	17	96%
Americium	180	131	73%	25	87%
Neptunium	91	63	69%	13	84%
Total	1569	1374	88%	114	95%

Conclusion for 1990-1998

- Considering:
 1. Majority of the most of this population (subcontractor CTWs) were monitored for each radionuclide
 2. We normally use the full uncertainty distribution of the co-worker distribution for the unmonitored worker and the 95th percentile is considered bounding
- *NIOSH continues to believe that coworker models developed from the workers with monitoring data are sufficient to:*
 1. *Estimate the dose to the few workers without monitoring data*
 2. *Supplement monitoring data for those with incomplete internal monitoring*

Subcontractor monitoring evaluation

Late DuPont era 1980-1989

Subcontractor Evaluation 1980-1989 (Late DuPont era)

- Only Job Plans / SWPs for A area were available
 - Job Plans primary source of information
 - *Job plans from other areas is what we believe might have been destroyed based on interviews with workers and discussions with records personnel*
 - SWP were being phased out after 1972
- Instead of random sampling, we did a census and evaluated all job plans that had subcontractor CTWs

Job Plan Pages 1980-1989

Year	Job Plan pages	DuPont CTW pages	% DuPont CTW	subCTW pages	% subCTW	All CTW pages	% all CTW pages
1980	610	200	32.8%	11	1.8%	211	34.6%
1981	473	95	20.1%	9	1.9%	104	22.0%
1982	645	150	23.3%	19	2.9%	169	26.2%
1983	782	160	20.5%	35	4.5%	195	24.9%
1984	505	135	26.7%	8	1.6%	143	28.3%
1985	924	170	18.4%	45	4.9%	215	23.3%
1986	715	70	9.8%	25	3.5%	95	13.3%
1987	423	55	13.0%	6	1.4%	61	14.4%
1988	30	2	6.7%	5	16.7%	7	23.3%
1989	0	0	0.0%	0	0.0%	0	0.0%
Totals	5107	1037	20.3%	163	3.1%	1200	23.5%

Subcontractor Evaluation 1980-1989 (Late DuPont era)

- Approximately 3% of the CTW work was subcontractors
- In total 591 subCTW monitoring evaluations
 - (1980-1989) - 219 unique subCTWs on 145 job plans
 - (1990-1998) - 429 unique subCTWs on 146 RWPs
- Same evaluation method as 1990-1998
 - Radionuclide by year, craft
 - Only A area data was available
 - No data in 1989

1980-1989 Plutonium Monitoring Evaluation - Year

Year	Bioassay Required	SubCTW monitored	% with bioassay	SubCTWs matched to Coworker	Effective % monitored
1980	6	3	50%	3	100%
1981	102	87	85%	13	98%
1982	29	23	79%	3	90%
1983	99	84	85%	15	100%
1984	51	38	75%	11	91%
1985	155	121	78%	28	96%
1986	116	91	78%	24	99%
1987	27	20	74%	4	89%
1988	6	5	83%	1	100%
Total	591	472	80%	102	97%

1980-1989 Plutonium Monitoring Evaluation - Craft

Craft	Bioassay Required	SubCTW monitored	% with bioassay	SubCTWs matched to Coworker	Effective % monitored
Boilermaker	31	29	94%	2	100%
Carpenter	102	92	90%	7	97%
Electrician	44	27	61%	16	98%
Iron/Sheetmetal	75	51	68%	19	93%
Laborer	91	85	93%	6	100%
Millwright	16	16	100%	0	100%
Painter	35	25	71%	10	100%
Pipefitter	172	123	72%	42	96%
Other	25	24	96%	0	96%
Totals	591	472	80%	102	97%

Subcontractor Bioassay Monitoring 1980-1989

Radionuclide	Bioassay required	SubCTWs monitored	% with bioassay	SubCTWs matched to Coworker with bioassay	% monitored or matched with a coworker
Plutonium	591	472	80%	102	97%
Strontium/FP	591	463	78%	120	99%
Americium	151	52	34%	63	76%
Total	1333	987	74%	285	95%

- Results for Pu and Sr are slightly (10%) lower than the 1990-1998 time period
- Percent monitored results for Am are significantly lower (34%)

Subcontractor Evaluation 1980-1989 (Late DuPont era)

- Additional Incident report data from F, H areas (1980-1989)
 - Limited data - Yes
 - Indications of reasonable monitoring in two other areas during the 1980-1989 time period
- Combined Evaluations
 - No significant difference by year, craft, or area (A, F, H)
 - Less monitoring (10%) than modern era but still a majority of workers monitored for plutonium and strontium.
 - Significantly lower percentage (34%) for Americium

1980-1989 Incident Monitoring Data - Year

Year	Pu Bioassay Required	SubCTW Pu Bioassay	% with Pu bioassay	Sr/FP Bioassay Required	SubCTW Sr/FP Bioassay	% with Sr/FP bioassay
1985	7	6	86%	1	1	100%
1986	2	2	100%	1	1	100%
1987	12	11	92%	3	2	67%
1988	18	17	94%	6	5	83%
1989	5	5	100%	1	1	100%
Total	44	41	93%	12	10	83%

Potential Americium Issue (Late DuPont era)

- Significantly lower percentage (34%) of subcontractor CTWs monitored for Americium
- *NIOSH seeks workgroup advice on whether direct monitoring data for a third of a vulnerable subpopulation with documentation that 76% is effectively monitored is sufficient for a valid co-worker model*
 - *1/3 is directly monitored*
 - *1/3 is working with a directly monitored worker*
 - *1/3 is unmonitored with no co-worker*

Conclusion for 1980-1989

- Considering:
 1. Less than 15% of the construction trades work was conducted by subcontractor CTWs.
 2. Majority of the subpopulation (subcontractors) were directly monitored for Plutonium and Strontium and a third of the subpopulation is monitored for Americium
 3. A majority (76%) of the subcontractor CTWs are effectively monitored for Americium
 4. We normally use the full uncertainty distribution of the co-worker distribution for the unmonitored worker and the 95th percentile is considered bounding

Conclusion for 1980-1989 cont.

- *NIOSH continues to believe that coworker models developed from the workers with Pu and Sr monitoring data are sufficient to*
 1. *Estimate the dose to the few workers without monitoring data*
 2. *Supplement monitoring data for those with incomplete internal monitoring*
- Americium monitoring may require further discussion

Subcontractor monitoring evaluation

Mid DuPont era 1972-1979

Subcontractor Evaluation 1972-1979 (Mid DuPont era)

- Again Only Job Plans / SWPs for A area were available
 - Job Plans primary source of information
- Instead of sampling, we did a census and evaluated all job plans that had subcontractor CTWs
- **NO data** (job plans or SWPs) was found for 1975-1979
 - Few job plans available from 1975 to 1979 but none indicated subcontractor CTW work
- Evaluation limited to 1972 to 1974 (3 years)

Job Plan Pages 1972-1979

Year	Job Plan pages	DuPont CTW pages	% DuPont CTW	subCTW pages	% subCTW	All CTW pages	% all CTW pages
1972	1167	320	27.4%	40	3.4%	360	30.8%
1973	1094	230	21.0%	40	3.7%	270	24.7%
1974	146	40	27.4%	5	3.4%	45	30.8%
1975	5	0	0.0%	0	0.0%	0	0.0%
1976	189	0	0.0%	0	0.0%	0	0.0%
1977	0	0	0.0%	0	0.0%	0	0.0%
1978	0	0	0.0%	0	0.0%	0	0.0%
1979	2	1	50%	0	0.0%	1	0.0%
Totals	2603	591	22.7%	85	3.3%	676	26.0%

Subcontractor Evaluation 1972-1974 (Mid DuPont era)

- Again approximately 3% of the construction trades work involved subcontractors
- In total 136 subCTW evaluations
 - (1972-1974) – 31 unique subCTWs on 59 job plans
 - (1980-1989) - 219 unique subCTWs on 145 job plans
 - (1990-1998) - 429 unique subCTWs on 146 RWPs
- Same evaluation method as previous two intervals
 - Radionuclide by year, craft
 - Only A area data was available
 - **No subcontractor CTW data** from 1975-1979

1972-1974 Plutonium Monitoring Evaluation - Year

Year	Bioassay Required	SubCTW Monitored	% with bioassay	SubCTWs matched to Coworker	Effective % monitored
1972	65	50	77%	11	95%
1973	64	18	28%	13	46%
1974	7	1	14%	1	29%
Total	136	69	51%	25	69%

- Marked decrease in plutonium monitoring by year
 - 1972 reasonable percentage (majority)
 - 1973 rather low percentage monitored
 - Very limited data in 1974 (4 job plans, 7 workers)

1972-1974 Plutonium Monitoring Evaluation - Craft

Craft	Bioassay Required	SubCTW monitored	% with bioassay	SubCTWs matched to Coworker	Effective % monitored
Carpenter	10	9	90%	1	100%
Electrician	10	6	60%	2	80%
Iron/Sheetmetal	5	4	80%	1	100%
Laborer	7	6	86%	1	100%
Pipefitter	104	44	42%	20	62%
Totals	136	69	51%	25	69%

Subcontractor Bioassay Monitoring 1972-1974

Radionuclide	Bioassay required	SubCTWs monitored	% with bioassay	SubCTWs matched to Coworker with bioassay	% monitored or matched with a coworker
Plutonium	136	69	51%	25	69%
Strontium/FP	136	101	74%	27	94%
Americium	1	0	0%	0	0%
Total	273	170	62%	52	81%

- Results for Pu and Sr are lower than both the 1980-1989 and 1990-1998 time periods, however percentage is dominated by 1972
- Only one data point for Am (worker not monitored)

Subcontractor Evaluation 1972-1979 (Mid DuPont era)

- Evaluation was limited and dominated by 1972 data
- Marked decrease in plutonium monitoring in 1973 and 1974
 - Less than majority of subcontractor Construction Trades Workers (CTWs) monitored for plutonium in 1973 and 1974
 - Strontium monitoring was better
 - Only one data point for americium

Subcontractor Evaluation 1972-1974 (Mid DuPont era)

- *NIOSH is interested in workgroup discussion on sufficiency of the monitoring data of this subpopulation (subcontractors) for a co-worker model*
- Considering:
 1. Less than 15% of the construction trades work was conducted by subcontractor CTWs
 2. Evaluation indicates some workers were monitored for Plutonium and a majority were monitored for Strontium/FP
 3. We normally use the full uncertainty distribution of the co-worker distribution for the unmonitored worker and the 95th percentile is considered bounding

Summary and Conclusions

Summary of SC&A's Previous Comments

- SC&A postulated that subcontractors were primarily on job-specific bioassay and therefore unmonitored

*Question of how “complete is complete enough” for coworker development can only be answered in context of coworker guidelines and stratification assumptions that have been validated – they guide what datasets can be legitimately applied. **However, 79% incompleteness strains credulity.** [Emphasis added] (SCA Presentation November 14,2017)*

Summary of SC&A's Previous Comments cont.

- SCA implied in November 2017 and December 2017 that only 21% of the subcontractors were monitored and a coworker model would not be valid due to incomplete monitoring data

*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). [emphasis added]*

NIOSH Conclusion

We respectfully disagree with SC&A's conclusions

- The random review of RWPs from 1990 to 1998 indicates that far more than 21% and in fact **most** (88%) subcontractor Construction Trades Workers (subCTWs) were directly monitored for the radionuclides of concern by either routine or job specific bioassay
- A census review of all job plans in A area, supplemented by incident reports from 1980 to 1989 also indicate that far more than 21% and again **most** (79%) subcontractor CTWs were directly monitored for Plutonium and Strontium/FP
 - *Americium monitoring (34%) may require some discussion*

NIOSH Conclusion

- The Job plan and TWP data were insufficient to fully evaluate whether subcontractor construction trades workers were sufficiently monitored or represented by co-workers in the 1972 to 1979 time period
- There was limited subcontractor CTW work (<15%) during this time interval and some subcontractors were clearly monitored and therefore part of the CTW coworker distribution.
- *NIOSH is interested in workgroup discussion on sufficiency of the monitoring data of this population (subcontractors) for a coworker model*

NIOSH Conclusion

- In this review NIOSH/ORAUT demonstrated that unmonitored workers worked alongside the monitored workers in the same radiological environment (*especially in the 1980 to 1998 time period*)
 - Bioassay data is present within individual monitoring records and can be used for dose reconstruction
 - These internal monitoring records can also be used to develop coworker models and subsequently used in dose reconstruction to supplement gaps in individual monitoring data

Coworker model use

- NIOSH develops coworker models because we recognize that some workers were not monitored.
- For a coworker model to be valid a representative sample is all that is needed
- If all exposed workers were monitored (100%) for every radionuclide, there would not be a need for a coworker model

SC&A Conclusion *(Table 16 Comparison)*

Time Period	RPRT-0092 Monitored at least one radionuclide	SC&A Directly monitored for all radionuclides on Work Permit	RPRT-0092 Effectively monitored for at least one radionuclide	SC&A effectively monitored for all radionuclides on work permit
1972-1974	76%	47.1%	85%	55.1%
1975-1979	No data	No Data	No Data	No Data
1980-1989	90%	51.3%	99%	65.5%
1990-1998	96%	77%	97%	89%

Proposed Status Summary

- Evaluation status summary

Era	Subcontractors Evaluated	Valid Coworker model				
		Pu	Sr/FP	U	Am	Np
1990-1998	Yes	Yes	Yes	Yes	Yes	Yes
1980-1989	Yes	Yes	Yes	N/E	TBD	N/E
1972-1979	Partial (years missing)	TBD	TBD	N/E	TBD	N/E

N/E = Not evaluated (no data available to evaluate)

TBD = To be determined

Evaluation Timeline

Can we find a more efficient way?

RWP Evaluation Timeline

- February 2018 – Discussed RWP Sampling with SRS Workgroup
- March 2018 – Onsite RWP inventory to develop sampling plan
- April 2018 – Draft Sampling Plan submitted to Workgroup
- May 2018 – Sampling Plan Finalized
- June 2018 – Onsite Data Capture (2 weeks)
- July 2018 – Data Capture Completed (1 week)
- September 2018 – Receipt of Captured Data
- October 2018 – Draft report submitted to SRS
- November 2018 – February 2019 Additional documentation from Data Capture requested as draft report underwent internal review and revision
- June 2019 – Document approved and submitted to Workgroup (**16 months**)
- November 2019 – Received SC&A Comments on the Report (21 months)

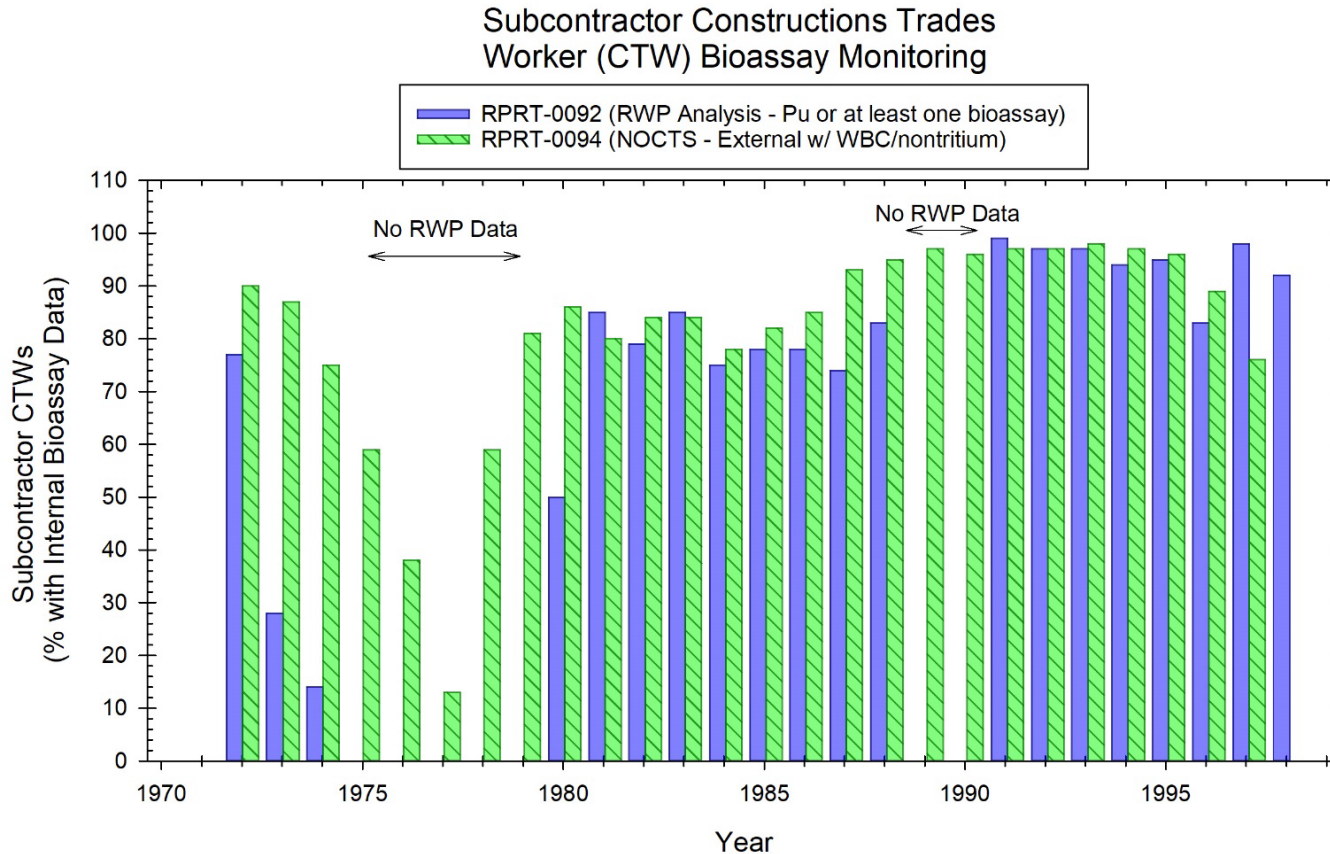
Why Discuss the Timeline?

- This is **VERY** labor intensive and difficult analysis even for a site that has very good monitoring records
- Currently attempting to repeat the RWP analysis for Los Alamos National Laboratory
 - SC&A raised fairness issue indicating that NIOSH did this work for SRS therefore NIOSH should do it for LANL
 - If we attempt to do this evaluation for every site, these evaluations won't be completed for over a decade
- *Can we conduct a simpler evaluation and obtain the similar results or insight? Maybe...*

Evaluation of NOCTS data

- NIOSH/ORAUT looked at subcontractor monitoring using only NOCTS data (Claimant Data)
 - *Evaluated externally monitored subcontractor construction trades workers (subCTWs) (vulnerable subpopulation)*
 - *Evaluated internal monitoring in simplistic manner (no RWPs), just does the worker have internal monitoring data or not*
 - *non-tritium bioassay (actinides)*
 - *Whole Body Count (fission products)*

Comparison of Alternate Evaluation using NOCTS data



Evaluation of NOCTS data

- Potential Benefits
 - Simpler analysis that could look at individual radionuclides if requested
 - More resource efficient (less data capture and coding)
 - More timely analysis (less classification review)
- Potential Detriment
 - Cannot directly compare coworkers therefore the data completeness must be inferred