Dose reconstruction feasibility for subcontractor construction trades workers at the Savannah River Site (SRS) – *SEC00103*

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Overview

- Background
  - Savannah River Co-exposure Models
  - Co-exposure Implementation Guide
  - Radiological Monitoring at the Savannah River Site (SRS)
- Subcontractor Evaluations
  - Evaluation of Bioassay Data for Subcontracted Construction Trade Workers at the Savannah River Site *(ORAUT-RPRT-0092)*
  - Bioassay for Subcontractor Construction Trade Workers at the Savannah River Site from 1972 to 1997 *(ORAUT-RPRT-0094)*
  - Savannah River Site Plutonium Bioassay Logbooks
- Summary and Conclusion

Savannah River Site Co-Exposure Models

ORAUT-OTIB-0081

Co-exposure Model Development and Use

- NIOSH develops co-exposure models because we recognize that some workers were not monitored that in retrospect perhaps should have been monitored
- For a co-exposure model to be valid a *bounding or representative sample* of the workers is needed
- If all exposed workers were monitored (100%) for every radionuclide, there would not be a need for co-exposure models

SRS Co-exposure Model – *ORAUT-OTIB-0081*

- The internal dose models in ORAUT-OTIB-0081 form the basis as to why we believe that dose reconstruction is feasible for unmonitored workers at the Savannah River Site
- The internal dose co-exposure models were stratified, *a priori*, by Operations Workers (non-CTWs) and Constructions Trades Workers (CTWs)
  - This resulted in two separate co-exposure models for each radionuclide

Internal Dose Co-exposure Models for both non-CTWs & CTWs

- Section 4.1 Americium
- Section 4.2 Tritium
- Section 4.3 Plutonium
- Section 4.4 Uranium
- Section 4.5 Fission Products
- Section 4.6 Co-60
- Section 4.7 Cs-137
- Section 4.8 Neptunium
- Section 4.9 Thorium

Construction Trades Worker (CTW) Strata

- The CTW strata combines
  - DuPont Construction Trades Workers (select Roll 2 workers)
  - All other Construction Trades Workers (Roll 4, 5, and 6)
- Definition used in the evaluations is by payroll ID *(not employer)* in the 1972-1989 time period
- Subcontractors in Roll 4, 5, and 6 include
  - Miller-Dunn (Electricians)
  - B.F. Shaw (Pipefitters)
  - North Brothers (Insulators)

Co-exposure Implementation Guide

DCAS-IG-006 – Data Completeness

Issue: Incomplete Subcontractor Data for Co-exposure

- *Slide presented during 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*).

Issue: “Completeness” of subcontractor CTW data in the Co-exposure Models

- Co-Exposure Implementation Guide *(DCAS-IG-006)*
- *Section 2.2 Data Completeness*

  Once the measurement techniques have been found to be technically acceptable, the amount of available monitoring data must be evaluated to determine if there are sufficient measurements to ensure that the data are either bounding or representative of the exposure potential for each job/exposure category at the facility. This analysis should look, not only at the total amount of data that are available, but also consider any temporal trends in data availability. *[underline emphasis added]*

Co-exposure Implementation Guide - Completeness

- *If the number of potentially exposed workers in each category is unknown, a useful starting point is to look at the distribution of samples among the various categories of workers represented in the claimant population at that site. Table 1 provides an example of this for the categories of workers who were monitored for ^{239}Pu at the Nevada Test Site.*

Table 1: Number of Pu-239 Samples (Percent of Samples) by time period and Job Category at the Nevada Test Site

N/A	All Job-Specific Workers	Radsafety Staff	Laborers	Welders	Wiremen	Miners	Security
Total Number of Samples	290	206	2	0	0	8	74
1963-1967	30 (10.34%)	28 (13.59%)	2 (100.00%)	-	-	0 (0.00%)	0 (0.00%)
1968-1970	34 (11.72%)	31 (15.05%	0 (0.00%)	-	-	2 (25.00%)	1 (1.35%)
1971-1980	79 (27.24%)	76 (36.89%)	0 (0.00%)	-	-	3 (37.50%)	0 (0.00%)
1980-1992	147 (50.69%)	71 (34.47%)	0 (0.00%)	-	-	3 (37.50%	73 (98.65%)

Radiological Monitoring at SRS

SRS Radiological Control - Defense in Depth Approach

- 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 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)

Routine vs. Job-Specific Bioassay

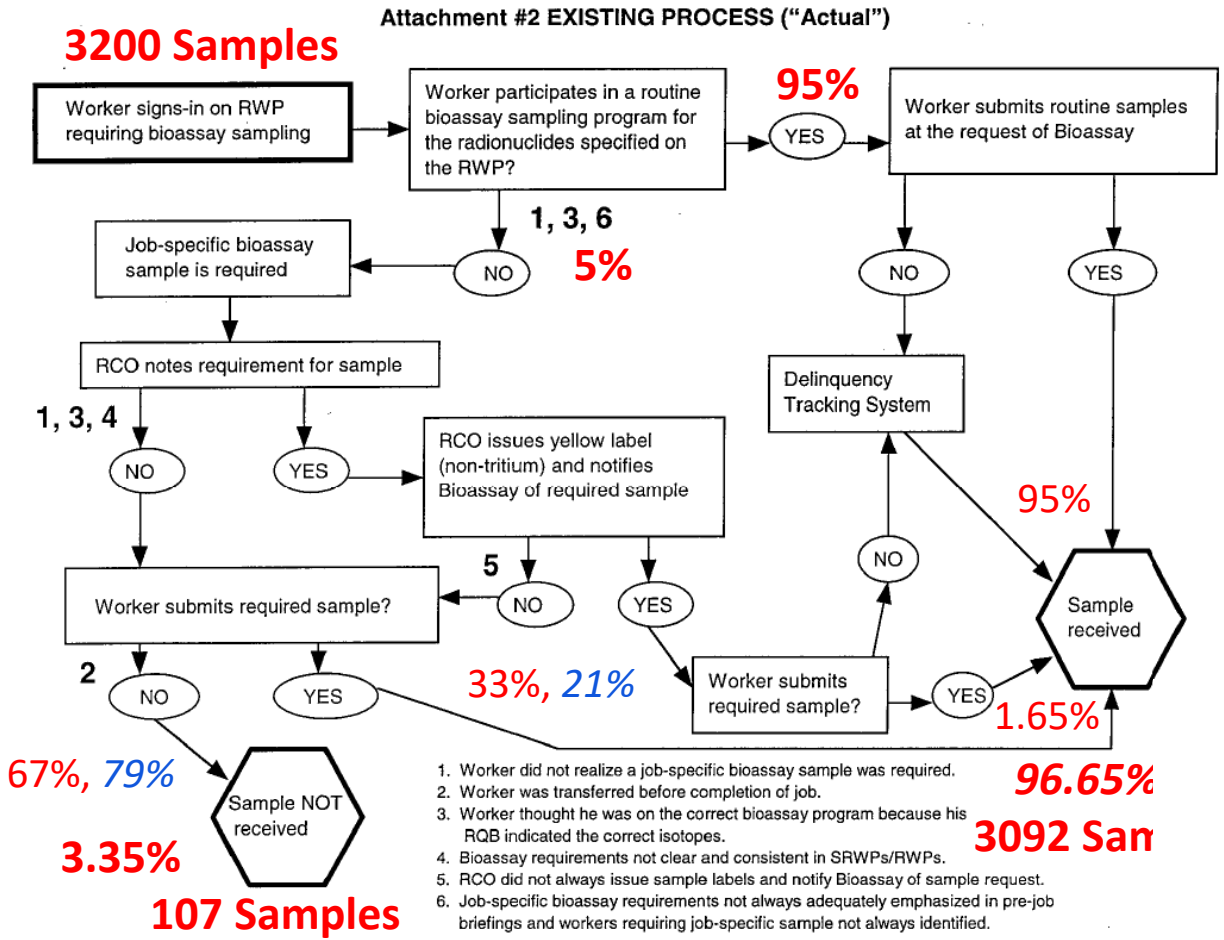
- Most workers (95%) were on routine bioassay
- SC&A postulated that subcontractors were primarily on job-specific bioassay

  > *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, NIOSH will show that the subcontractor monitoring was much greater than 21%

Subcontractor Monitoring

- Limited assessment of 3200 bioassay requirements – 33% compliance on Job-specific bioassay
- *Full assessment –"about 21% compliance" on Job-specific bioassay*
  - *≈ 324 Job-specific*
  - *≈ 6481 total bioassay*
- *1997 Total # of samples **NOT** received was 256*
- *100% follow-up of 256 workers indicated no intakes*



SRDB# 167757

Questions Examined NIOSH/ORAUT

- What fraction of Subcontractor Construction Trades Workers (CTWs) were monitored?
  - *Were subcontractors primarily monitored via job specific bioassay and therefore only a few subcontractors were actually monitored?*
  - *Did the subcontractor monitoring change over time, area, craft?*
  - *Did the unmonitored subcontractor CTWs work side by side with monitored subcontractor CTW workers (effectively monitored)?*
  - *Were subcontractors monitored for the correct radionuclides?*

Issue: Subcontractor Monitoring

- ***Are subcontractor construction trades workers bounded or sufficiently represented in the co-exposure model?***
- SC&A is saying ***NO*** they are not
  - *The basis for saying subcontractors are not bounded or sufficiently represented is not clear to NIOSH*
- NIOSH is saying ***YES*** they are
  - Based on an analysis of work permits and bioassay
  - Quantity of monitoring data available in NOCTS
  - Review of plutonium bioassay logbooks

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

ORAUT-RPRT-0092

3 Goals of the Subcontractor Evaluation

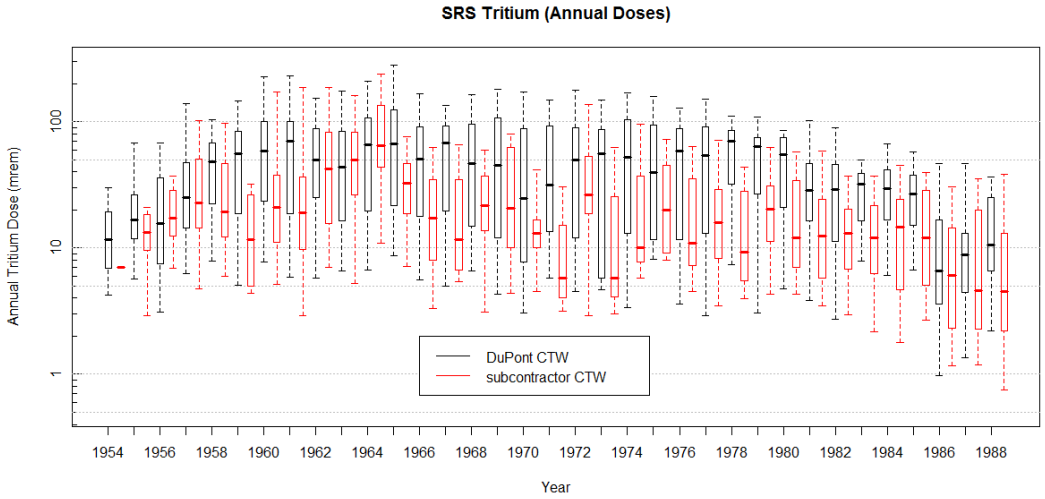
1. Determine the percentage of subcontractor Construction Trades Workers (subCTWs) monitored by year
2. Determine whether unmonitored subCTWs were represented by a monitored subCTW in the same radiological environment (same RWP) at the same time
3. Determine whether subCTWs were monitored for the radionuclides 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 Standing Radiation Work Permits (SRWPs) considered routine work
    - Excluded reactor areas (C,K,L,P,R) - low dose tritium

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



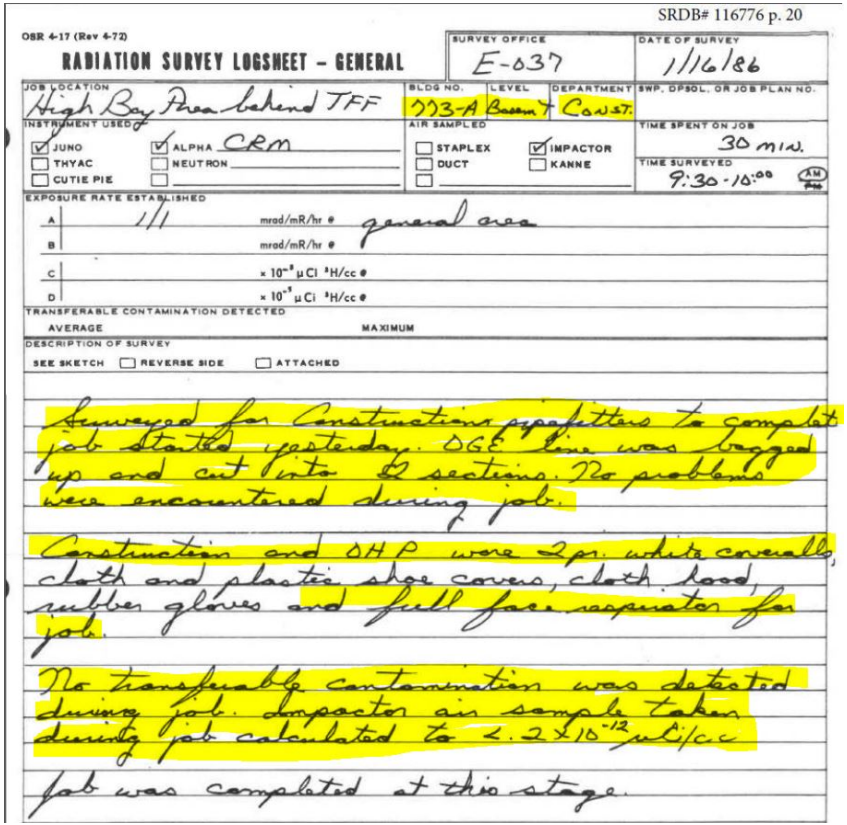
- Since 1980 the DuPont CTWs 95th percentile tritium dose has been less than 100 mrem with a downward trend.
- Conclusion tritium monitoring of subcontractors is not a dose reconstruction issue at SRS.

Critical Assumption in RPRT-0092 Evaluation

- "Respirator use" is a reasonable conservative surrogate for the need for internal monitoring, however, we recognize not all respirator use requires bioassay
- Some use of respiratory protection is precautionary (e.g. in case something happens or if contamination is unexpectedly encountered)
- If there is no contamination, then there is no potential for an intake and bioassay is not necessary
  - RWP evaluation did not consider this effect

Example of respirator use where bioassay was not needed

- No transferable contamination
- Air concentration less than 0.2×10^{-12} uCi/cc
- <10% of Derived Air Concentration - DAC



SRDB# 116776 p. 20

OSR 4-17 (Rev 4-72)

RADIATION SURVEY LOGSHEET – GENERAL

SURVEY OFFICE: E-037

DATE OF SURVEY: 1/16/86

JOB LOCATION: High Bay Area behind TFF

BLDG NO.: 773-A

LEVEL: Basement

DEPARTMENT: Const.

SWP, OPSOL, OR JOB PLAN NO.:

INSTRUMENT USED

- [x] JUNO
- [ ] THYAC
- [ ] CUTIE PIE
- [x] ALPHA CRM
- [ ] NEUTRON

AIR SAMPLED

- [ ] STAPLEX
- [ ] DUCT
- [x] IMPACTOR
- [ ] KANNE

TIME SPENT ON JOB: 30 min.

TIME SURVEYED: 9:30 - 10:00 AM

EXPOSURE RATE ESTABLISHED

A: 1/1 mrad/mR/hr @ general area

B: mrad/mR/hr @

C: $\times 10^{-6}$ µCi ^{3}H/cc @

D: $\times 10^{-6}$ µCi ^{3}H/cc @

TRANSFERABLE CONTAMINATION DETECTED

AVERAGE MAXIMUM

DESCRIPTION OF SURVEY

SEE SKETCH ☐ REVERSE SIDE ☐ ATTACHED

Surveyed for Constructions pipefitters to complete job started yesterday. DGE line was bagged up and cut into 2 sections. No problems were encountered during job.

Construction and SHP were 2 ps. white coveralls, cloth and plastic shoe covers, cloth hood, rubber gloves and full face respirator for job.

No transferable contamination was detected during job. Impactor air sample taken during job calculated to < 2×10^{-12} µCi/cc

Job was completed at this stage.

Westinghouse Era (1990-1998)

ORAUT-RPRT-0092

1990-1998 Plutonium Monitoring Evaluation - Year

Year	Bioassay Required	# of RWPs	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%

1990-1998 Plutonium Monitoring Evaluation - Area

Area	Bioassay Required	No of RWPs	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%

1990-1998 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%

1990-1998 Subcontractor Bioassay Monitoring

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%

Late DuPont Era (1980-1989)

ORAUT-RPRT-0092

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 are what we believe might have been destroyed based on interviews with workers and discussions with records personnel*
    - *Note that job plans are not considered permanent records*
  - SWPs 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 1980-1988

- 5107 job plan pages were reviewed
- 1200 (23.5%) involved Construction Trades Workers
  - 1037 (20.3%) – DuPont Construction Trades Workers (Roll 2)
  - 163 (3.2%) – subcontractor CTWs (Roll 4, 5 and 6)
- Approximately 3% of the total off-normal work was conducted by subcontractors CTWs
- Approximately 14% of construction work was conducted by subcontractor CTWs

Subcontractor Evaluation 1980-1989 (Late DuPont era)

- 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 lower (10% less) than the 1990-1998 time period
- Percent monitored results for Am are lower (34%)

Subcontractor Evaluation 1985-1989 (Late DuPont era)

- Additional incident report data from F and H areas (1985-1989)
  - These are the areas where plutonium is separated
  - Is this limited data? – Yes, but represents the upper bound of the exposure potential
- Question: *Is there evidence that subCTWs were monitored following incidents?*

1985-1989 Incident Monitoring Data, F&H Area - 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%

Subcontractor Evaluation 1980-1989 (Late DuPont era)

- Clear indications for 3 areas of sufficient monitoring of subcontractor CTWs during the 1985-1989 time period for plutonium and strontium/mixed fission products
- Combined Evaluation
  - 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
  - Lower percentage (34%) for americium

Mid DuPont Era (1972-1979)

ORAUT-RPRT-0092

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 again did a census and evaluated all job plans that had subcontractor CTWs
- ***NO data*** (job plans or SWPs) was found for 1975-1979 to conduct an evaluation
  - Few job plans available from 1975 to 1979 but none indicated subcontractor CTW work
- Evaluation limited to 1972 to 1974 (3 years)

Subcontractor Evaluation 1972-1974 (Mid DuPont era)

- Again, approximately 3% of all work in A area off normal work involved subcontractors, and approximately 14% of construction work was conducted by subcontractor CTWs
- 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

RPRT-0092 Summary (RWP Analysis)

- 1990-1998 – Evaluation across time, area, and craft indicated subcontractor CTWs were monitored (88%) and would be sufficiently represented in a co-exposure model
- 1980-1989 – Evaluation across time and craft in one area indicated subcontractor CTWs were monitored (74%) and would be sufficiently represented in a co-exposure model. Evaluation of incident data in two other areas indicate that subCTWs with highest exposure potential are represented in the co-exposure model
- 1972-1979 – Limited data evaluation for first 3 years in one area indicates subcontractor CTWs are represented.

Bioassay for Subcontractor Construction Trade Workers at the Savannah River Site from 1972 to 1997 *(ORAUT-RPRT-0094)*

ORAUT-RPRT-0094

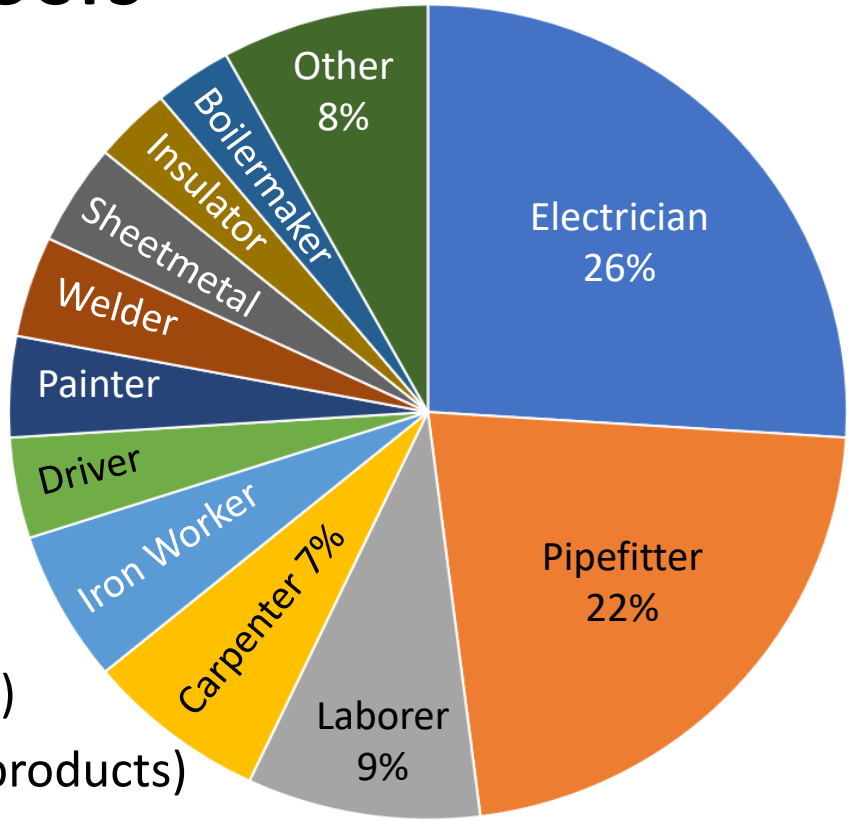
Subcontractor monitoring in NOCTS

- SRS/SEC Issues Workgroup discussions since 2017 have focused on RWP / Job Plan *(ORAUT-RPRT-0092)* and Co-exposure models
- NOCTS data analysis *(ORAUT-RPRT-0094)* has not been discussed during the SRS/SEC Issues workgroup meetings
  - NIOSH requested workgroup members consider this report before recommending a Class be added to the SEC
- NIOSH/ORAUT evaluated subcontractor monitoring using only NOCTS data (Claimant Data)
  - 6097 Total SRS Claimants
  - 886 (15%) Subcontractor CTWs

Subcontractor monitoring in NOCTS

- 886 Subcontractor CTWs
  - Craft Distribution

- NIOSH Evaluation
  - External Monitoring
  - Internal Monitoring
    - Tritium bioassay
    - non-tritium bioassay (actinides)
    - Whole Body Counting (fission products)



Focus of the NOCTS data evaluation

- Focus on externally monitored subcontractor construction trades workers (subCTWs)
  - New Construction vs. Renovation/Remodeling/D&D
  - Not all externally monitored work required internal monitoring
- Benefits of analysis:
  - Not limited to specific area, (e.g. covers all areas)
  - Represents data used in Dose Reconstruction
  - Simplistic internal analysis

Why the simplistic internal monitoring approach?

- Radionuclide specific internal monitoring depends on where the worker conducted their work *(SRS is a Very Large Site)*
  - Subcontractors in reactor areas likely didn't need plutonium monitoring, but may have needed tritium or fission products
  - Subcontractors in plutonium areas likely didn't need tritium monitoring
  - Subcontractors in tritium areas likely didn't need plutonium or fission product monitoring
- ***Fundamental question: Are subcontractors sufficiently represented or bounded in the co-exposure models?***

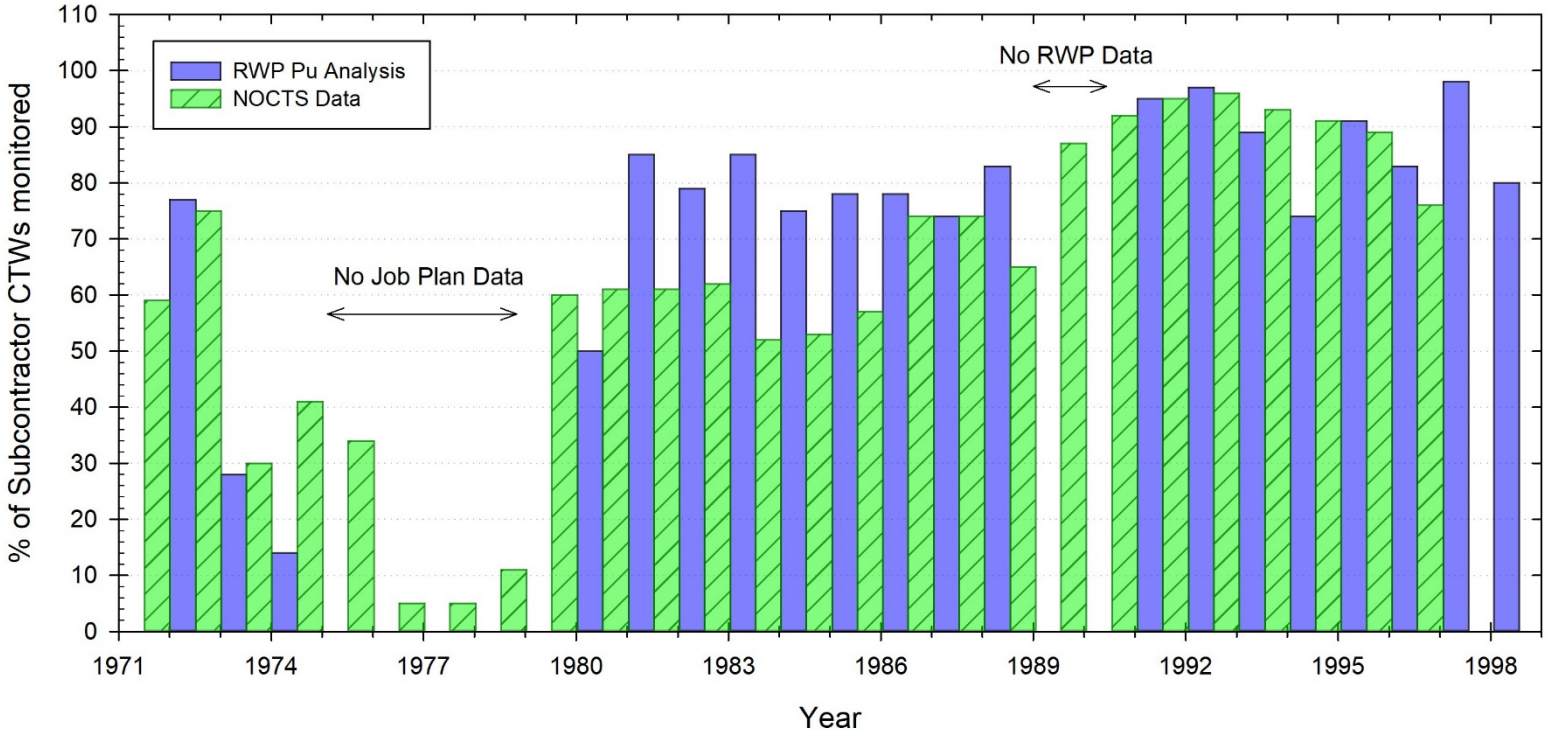
Example Attachment B of ORAUT-RPRT-0094

subcontractor CTWs who started in 1980 (page 47)

Craft	Internal Monitoring Evaluation	80	81	82	83	84	85	86	87	88	89	90	91	92
Electrician	Yes – Internal in Last Year of External Monitoring[1]	N[1]	ET[1]	N[1]	nd	nei	nd	nd	nd	EW[1]	nd	nd	nd	nd
Electrician	N/A – Employment after 1997	EN[1]	EN[1]	EN[1]	EN[1]	E[2]	E[2]	N[1]	EN[1]	ET[1]	EWT[1]	EWT[1]	EWT[1]	EWT[1]
Electrician	No – External after Last Internal Monitoring[2]	N[1]	EN[1]	E[2]	N[1]	E[2]	nd	nd	nd	nd	nd	nd	nd	Nd
Insulator	Yes – Internal in Last Year of External Monitoring[1]	E[1]	ENT[1]	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Laborer	Yes – Internal in Last Year of External Monitoring[1]	EN[1]	N[1]	N[1]	EN[1]	EN[1]	EN[1]	E[2]	EN[1]	E[2]	EWT[1]	EWT[1]	EN WT[1]	EN WT[1]

1 = bioassay data; **2** = no bioassay data; E = External monitoring, N = Non-tritium urine bioassay, T = Tritium urine bioassay, W = Whole Body Count, nd = not employed: no data, nei = employed: but no external or internal monitoring

Comparison RWP Analysis and NOCTS Claimant Data



RPRT-0094 Summary (NOCTS data)

- 1990-1998 – High percentage of subcontractor (>75%) CTWs in NOCTS were monitored and would be sufficiently represented in a co-exposure model
- 1980-1989 – Moderate percentage (>50%) of subcontractor CTWs in NOCTS were monitored and would be sufficiently represented in a co-exposure model
- 1972-1979 – Initially a moderate percentage of subcontractor CTWs were monitored for internal exposures, however, there is a marked decrease into the late 1970s followed by a surge of monitoring starting in 1980
  - ***Similar pattern as observed in the "limited" RWP evaluation***

Plutonium Bioassay Logbooks

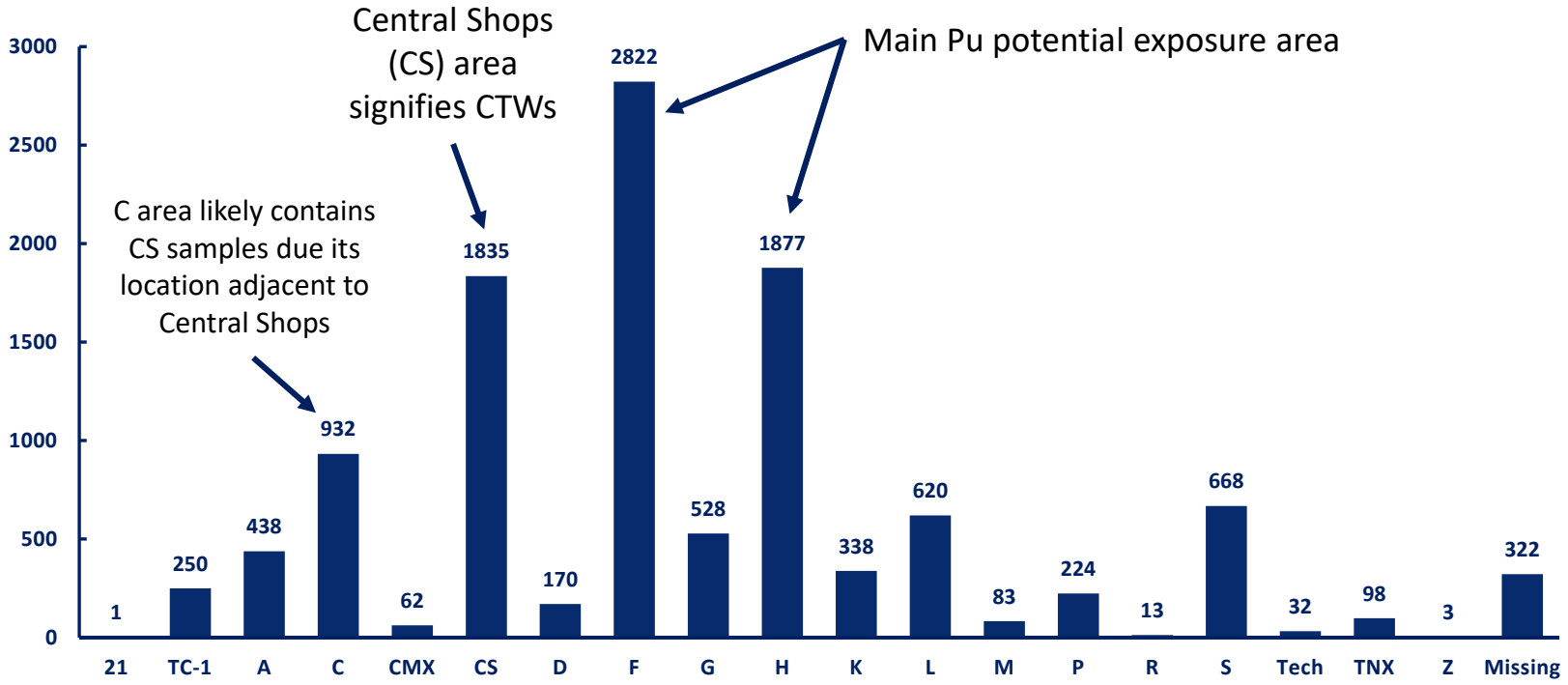
1972-1990

NIOSH Review of SRS Plutonium Bioassay Logbooks

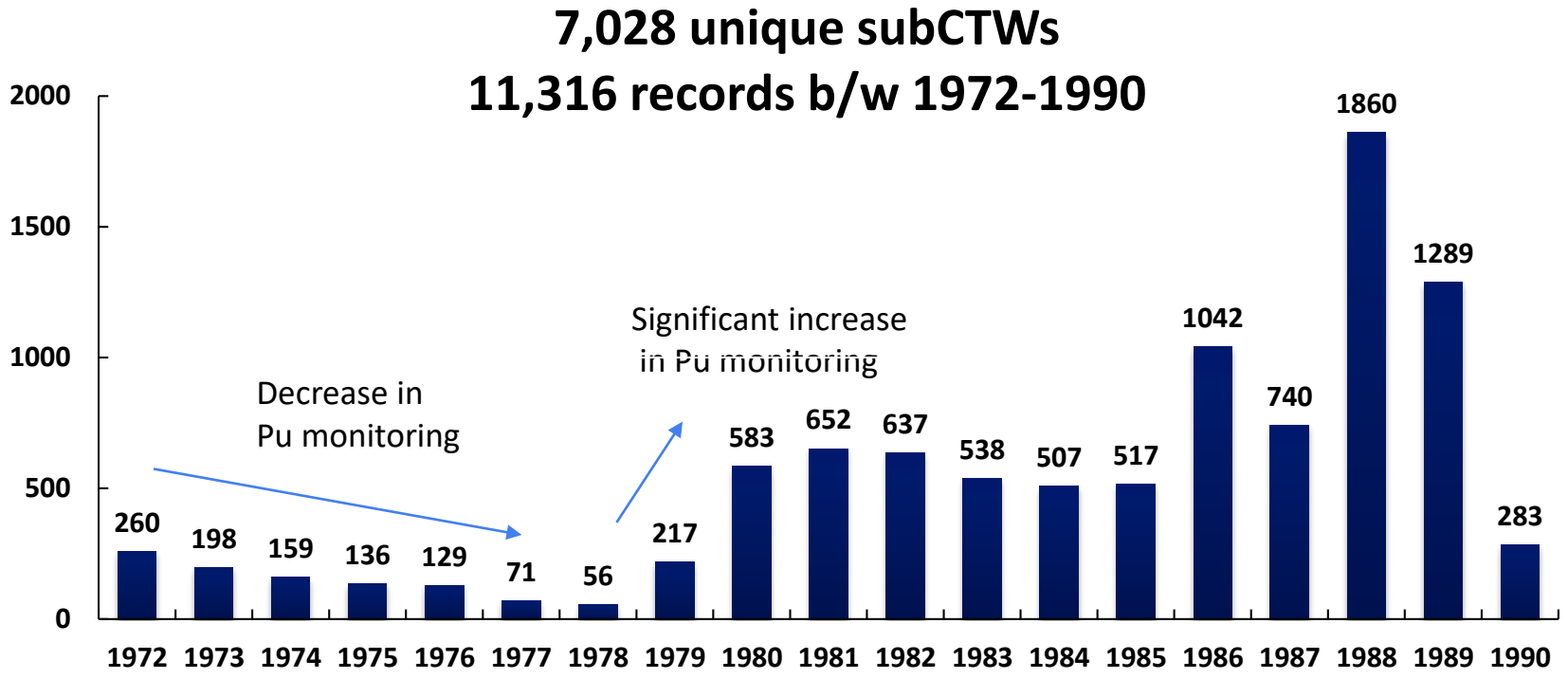
- NIOSH reviewed available SRS plutonium bioassay logbooks (1972-1990) in order to determine a more complete picture of bioassay monitoring practices for subcontractor CTWs
  - 11,316 Plutonium bioassay samples from subcontractor CTWs
  - 7,028 individual subcontractor CTWs
  - Samples submitted from at least 23 areas at the site
    - Main Plutonium Areas (F, H, and A)
      - F and H were bulk plutonium production areas
      - A area was Research & Development area

Approximate # Pu bioassay samples for subCTWs by Area (1972-1990)

N=11,316



SRS # subCTWs identified from Pu bioassay logbooks (1972-1990)



NIOSH Review of Plutonium Bioassay Logbooks

- NIOSH believes that subCTWs were sufficiently monitored in areas outside 773-A between 1972 and 1990
- Similar pattern of internal monitoring was observed in the RWP analysis, the NOCTS data analysis, and now the plutonium bioassay logbook analysis
  - Decrease in plutonium monitoring in 1970s
  - Surge (10x) of plutonium monitoring starting around 1980

Summary and Conclusion

Weight of the Evidence (1 of 3)

- Three sources/evaluations of subcontractor bioassay data
  - RWP / Job Plan to bioassay (ORAUT-RPRT-0092)
  - NOCTS Claimant Data (ORAUT-RPRT-0094)
  - Plutonium Bioassay Logbooks
- All three evaluations show similar results for plutonium

Weight of the Evidence (2 of 3)

- 1990-1997 Robust monitoring of subCTWs
  - RWP analysis (temporal, multiple area, craft)
  - NOCTS data analysis - high percentage (>75%) of subCTWs monitored
- 1980-1989 acceptable monitoring of subCTWs
  - Job Plan analysis (A area, temporal, craft)
  - Co-exposure model is bounding based on incident data in F & H area
  - NOCTS data & Pu bioassay analysis – moderate percentage (>50%) of subCTWs monitored

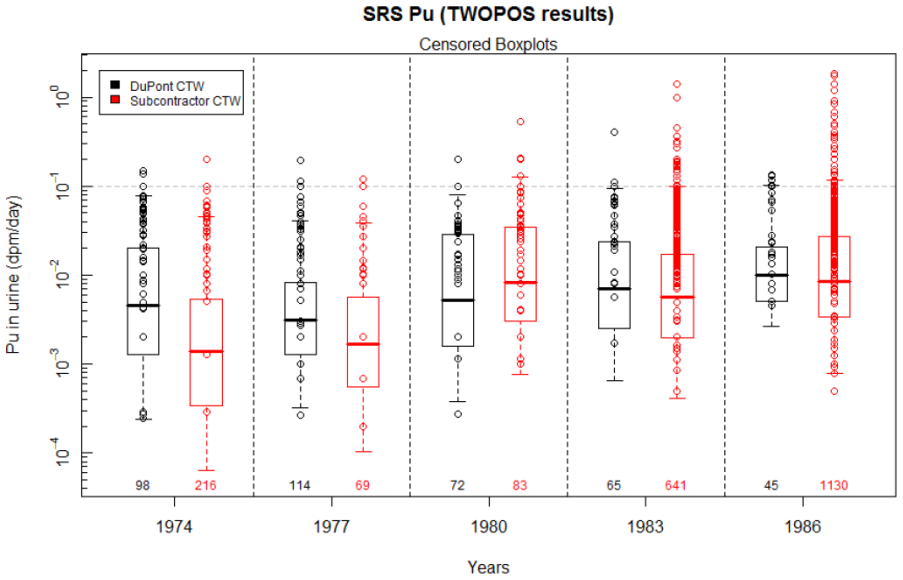
Weight of Evidence (3 of 3)

- 1972-1979 limited evaluation and limited monitoring of subCTWs
  - RWP analysis – limited evaluation (3 years, one area)
  - NOCTS & Pu bioassay analysis – limited monitoring (1226 bioassay)

- Evaluation method was conservative
  - Did all subCTW jobs requiring respirators need bioassay?
  - SubCTW work in this time frame constituted approximately 14% of the total construction work, major majority was DuPont CTWs
  - DuPont CTW workers are likely bounding for subCTWs

Sub-stratification analysis

- Over 95% of the plutonium bioassay data is below the reportable level of 0.1 dpm/day
- Bioassay data from DuPont or prime CTWs (Roll 2) appear to be slightly greater than subcontractor CTWs (Roll 4, 5, and 6)
- When co-exposure models are developed, the Pu intakes for the two populations are quite similar



Sub-stratification Type-S Plutonium Intake Results

Year	prime-CTW 50th % (dpm/d)	prime-CTW 84th % (dpm/d)	prime-CTW 95th % (dpm/d)	subCTW 50th % (dpm/d)	subCTW 84th % (dpm/d)	subCTW 95th % (dpm/d)
1973-1978	**15.71**	88.27	268.7	6.97	48.5	169.4
1979-1987	**26.38**	110.7	279.2	22.65	114.6	326.1

Bold denote higher 50^{h}% Intakes
Underline denote higher 95th% Intakes

Effect of Co-exposure models

- Based on NOCTS data analysis (RPRT-0094) there are six years (1974-1979) where the percentage of internal monitoring via non-tritium and WBC is less than 50%
- To bias the co-exposure models, exposures to *unmonitored* subcontractor CTWs would have to be significantly higher than the *monitored* subcontractor CTWs
  - Considering the zero-intake policy and defense in depth approach to radiological protection, coupled with the Health Physics coverage of the construction jobs, we don't believe this is plausible when for most years the monitored subcontractors outnumber the unmonitored subcontractors

Conclusion (1 of 2)

- 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 within individual monitoring records can be used for dose reconstruction for most subcontractor Construction Trades Workers
  - These internal monitoring records can also be used to develop co-exposure models and subsequently used in dose reconstruction to supplement gaps in individual monitoring data

Conclusion (2 of 2)

- We do not see any evidence where subcontractor construction trades workers were not monitored to a degree that would bias the co-exposure models
- Based on the weight of the evidence, NIOSH believes that the co-exposure models are bounding and representative of the exposures that would be received by an unmonitored subcontractor construction trades worker
- NIOSH concludes that dose reconstruction is feasible

Questions?

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.