NIOSH RESPONSES TO SC&A FINDINGS ON ORAUT-RPRT-0077

Response Paper

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The Oak Ridge Associated Universities Team (ORAUT, the Team) issued *Evaluation of Health Physics Area and Health Physics Department Codes to Identify Neptunium Workers at the Savannah River Site* to address identification of neptunium workers (ORAUT 2016). SC&A reviewed this document and issued its findings and observations in SCA-TR-2017-SEC006 (SC&A 2017). To respond to SC&A's concerns, the Team analyzed two datasets taken from NOCTS:

1. The first dataset (the Intake Set) is comprised of the 86 records from the intake database identified by SC&A as those records for which they could not find SRS HP Area (HPA) and or HP Department (HPD) code values. The Intake Set contains claimants with DOE-reported positive bioassay results for either Np-237 or Pu-238.

2. The second dataset (the CATI set) is comprised of random records selected from NOCTS claims containing "235-F" in the CATI (i.e., claimants who mentioned Building 235-F in their work history). Only findings and observations for periods from 1973 through 1995 are addressed in this response (the period before 1973 is covered by an SEC class; 10 C.F.R. 835 went into effect on January 1, 1996).

Although SC&A states that HPRED is the official record for external dose supplied for SRS claimants, data are also supplied from HPAREH and PRORAD. In addition, data from quarterly and cycle external dosimetry reports are provided by SRS and are available in the SRDB. Claimant monitoring data reported by SRS may be supplemented by these reports.

The following are SC&A's findings and observations along with the Team's responses:

SC&A Observation 1: *Section 8.0 of NIOSH 2016a would benefit from explicit instructions or descriptions, or both, on how NIOSH plans to implement the proposed approach of using HPA and HPD codes to assign Np-237 co-worker intakes. Additionally, an example dose reconstruction using actual claimant records would help illustrate how the methodology would function in practice.*

ORAUT Response: Dose reconstructors (DRs) currently record HP Area (HPA) by cycle/quarter as part of assigning external dose. DRs use a template similar to the one shown Figure O1-1.

Year	HP Area	Cycle #	Code	OW	S
1974		1			
		2			
	1K	3			
		4			
		5			
	2F	6		0	0
	2F	7		0	0
		8			
		9			
	2F	10		0	0
		11			
		12			
1975	2F	1		0	0
		2			
		3			
	2F	4		0	0
		5			
		6			
	1C	7		0	0
		8			
		9			
	1C	10		0	0
		11			
		12			

Figure O1-1

As part of assigning internal dose, DRs will use the HPA data entered in the external dose template (Figure O1-1) to determine when Np-237 co-worker doses should be applied to the claimant using a template similar to Table O1-1. For each employment year the DR will enter any qualifying HPA code in the table. For any calendar quarter (groups in cycles of three) with no HPA the DR should look for an HPA for the claimant in the SRS quarterly dosimetry summary for the quarter. With the example in Table O1-1 the HPA code 2F was observed in 1974-1975 while the code 2H was observed in 1977. No qualifying HPA code was observed in 1976. The DR will record any of the HPA codes identified in the conclusion of this response. Completion of the HPA for the template represented by Table O1-1 may be programmed in the SRS dose reconstruction tool to automate completion of the form using the HPA data entered in for external dose in Figure O1-1. A claimant will need only one qualifying HPA code in a year; neptunium co-worker dose will be assigned for the entire year for those workers without a neptunium bioassay or neptunium in vivo result.

Table O1-1. Assign Np Co-worker Dose.

Year	HP Area
1974	2F
1975	2F
1976	None
1977	2H

For the example data used in Table O1-1 above, the DR would assign neptunium co-worker dose for 1974, 1975, and 1977.

SC&A Observation 2: *The issue of what constitutes appropriate worker coverage for applying co-worker intakes of neptunium is central to NIOSH 2016a. Such judgments are not necessarily technical in nature but are common in the practical implementation of any unmonitored dose assignment. Thus, the issue of sufficient worker coverage in the context of using HPA and HPD codes for dose assignment should be carefully considered by the SRS Work Group.*

ORAUT Response: Observation noted.

SC&A Finding 1: *Of the 173 documented intakes of Np-237 and Pu-238 identified among the claimant population, 43% had associated dosimetry records that did not identify an HPD code and 25% that did not identify an HPA code.*

ORAUT Response: The Team analyzed each of the records from the Intake Set for which SC&A could not locate HPA code values, and where the date of the bioassay indicating the exposure was on or after January 1, 1973. SC&A reported HPA values not found for 31 persons; some were for the same person on different dates, resulting in 40 worker-year combinations.

Using site dosimetry reports found in the SRDB, the Team found HPA values for each of the 40 worker-year combinations. For each, an HPA code was found that was reported for the calendar quarter that included the bioassay date showing a positive Np-237 or Pu-238 analytical result.

Codes identified in this effort expanded the list of HPA codes previously identified for workers with potential for routine exposures to neptunium.

SC&A Observation 3: *When HPA and HPD codes were provided in the available external dosimetry records associated with confirmed intakes, the codes showed reasonable agreement with the analyses in Sections 5-1 and 5-2 of NIOSH 2016a. SC&A agrees that, in general, these codes represent the cohort of workers most likely to have been exposed to neptunium. However, the SC&A analysis identified HPD and HPA codes associated with construction trades that are likely important for the assignment of co-worker doses despite not being seen as frequently as the HPA and HPD codes typically associated with operations personnel.*

ORAUT Response: HPA and HPD codes for construction workers are addressed in ORAUT responses to SC&A Findings 1 and 4 - 8.

SC&A Observation 4: *For the period from 1959 through March 1963, badges were exchanged on a biweekly frequency. Approximately 80% of the cases examined during this period contained examples in which multiple HPA codes were identified for the same badging cycle. This indicates that changes in work area were being tracked by the dosimetry branch and that information is available in the claimant monitoring records supplied by DOE.*

ORAUT Response: This issue will be considered as part a technical basis document revision.

SC&A Observation 5: *Beginning in April 1963 and extending through December 1972, available dosimetry records are reported on a quarterly basis, although dosimeters were exchanged on either a biweekly or monthly basis. Therefore, work location can only be assessed (at a minimum) on a quarterly basis for this period.*

ORAUT Response: Biweekly and monthly dosimetry reports are available in the SRDB. This issue will be considered as part of a technical basis document revision.

SC&A Finding 2: *During the period from April 1963 to December 1972, SC&A found no evidence that multiple HPA codes were being assigned during a given badging cycle, which would allow for identifying worker movements among different areas. Unlike the previous period, it does not appear that the dosimetry department was using the HPA codes to track all worker movements during a given badging cycle.*

ORAUT Response: Biweekly and monthly dosimetry reports are available in the SRDB. This issue will be considered as part of a technical basis document revision.

SC&A Observation 6: *SC&A identified two cases in which no quarterly exposure reports were available from April 1963 to December 1972; however, annual exposure summaries indicate that positive doses were accrued during this timeframe. Through a process known as "hot-linking," NIOSH has identified selected quarterly reports for these two individuals in the years 1967 to 1970. Therefore, the dosimetry records may not be missing; however, they are currently unavailable in the DOE-supplied records.*

ORAUT Response: Quarterly dosimetry reports are available in the SRDB. This issue will be considered as part of a technical basis document revision.

SC&A Finding 3: *Several reviewed claims had incomplete quarterly dosimetry records (i.e., a summary report was not supplied for each relevant quarter). For many of those cases, it appears that quarterly reports that reflected no positively accrued dose were omitted by DOE. In other cases, however, missing quarterly reports are representative of positive exposure periods, as evidenced by comparison with annual totals.*

ORAUT Response: Quarterly dosimetry reports are available in the SRDB. This issue will be considered as part of a technical basis document revision.

SC&A Finding 4: *External dosimetry cycle data extracted from HPRED for the years 1973–1981 do not contain an area designation (HPA code) or indications of the department (HPD code). Some claims reviewed contained limited individual cycle reports that can be used to supplement the HPRED data. However, 97% of the reviewed claims had at least some dosimetry cycles during which no work area could be determined.*

ORAUT Response: The Team analyzed each of the records from the Intake Set for which SC&A could not locate either the HPA or HPD. HPA values were reported as not found for 31 workers; some for multiple years, resulting in 40 worker-years combinations. The Team found HPA values for each of the 40 worker-year combinations. Table F4-1 shows the results.

Table F4-1.

Intake Set Number	Year	HP AREA	HP DEPT	Source
1	1975	5A	911	DuPont 1975a
3	1973	2H	500	DuPont 1977a
7	1973	2F	205	DuPont 1977a
8	1979	2H	209	DOE Response
32	1977	2H	500	DuPont 1977a
32	1978	2H	500	DuPont 1978
32	1979	2H	500	DuPont 1979a
32	1979	2H	500	DuPont 1979b
32	1980	2H	500	DuPont 1980a
38	1975	2F	200	DuPont 1975b
48	1973	2H	203	DuPont 1977a
49	1975	2F	500	DuPont 1975b
49	1977	2F	500	DuPont 1977a
78	1975	2H	500	DuPont 1975b
89	1973	2H	209	DuPont 1977a
89	1975	2H	203	DuPont 1975a
90	1973	2H	500	DuPont 1977a
93	1974	2F	501	DuPont 1974
96	1975	1C	200	DuPont 1975b
99	1975	2H	203	DuPont 1975b
100	1975	2H	203	DuPont 1975c

Intake Set Number	Year	HP AREA	HP DEPT	Source
102	1974	2H	500	DuPont 1974
102	1975	2H	500	DuPont 1975a
104	1975	2H	203	DuPont 1975b
105	1977	2F	501	DuPont 1977b
113	1973	2H	500	DuPont 1973b
113	1974	2H	500	DuPont 1974
113	1976	2H	500	DuPont 1976
114	1976	2H	500	DuPont 1976
115	1980	7A	40	DuPont 1980b
116	1980	2H	209	DuPont 1980a
117	1980	2F	501	DuPont 1980a
120	1981	2F	601	DuPont 1981a
143	1988	5A	969	DuPont 1988
145	1976	2H	602	DuPont 1976
157	1975	2H	203	DuPont 1975a
164	1981	2F	501	DuPont 1981b
185	1983	2F	501	DuPont 1983a
188	1981	2H	203	DuPont 1981c
202	1981	7A	40	DuPont 1981d

Table F4-2 shows the HPA codes identified in the review of the 40 worker-year combinations (DuPont Unknown); Table F4-3HPD codes identified (DuPont 1977c).

Table F4-2.

HPA code	Location
1C	100-C
2F	200-F
2H	200-H
4H	232-234-H
5A	773-A
7A	CS

Although the HPA code 1C was listed with one of the worker-year combinations, further investigation of that intake showed that the individual was a reactor worker who had entered a canyon without respiratory protection. The worker was exposed only to plutonium, not neptunium. Therefore, the single instance of 1C is not considered an identifier for neptunium work. Nonetheless, an HPA code was found for the worker for the period covering the intake.

The Team identified two instances of the HPA code 7A. Although 7A was not listed in ORAUT 2016, Section 8, the code was used to designate Central Shops, which is an HPA code for identifying construction trade workers.

Table F4-3.

HPD code	Department or Group
040	Construction
200	Separations: F Canyons
203	Separations: H Canyons
205	235-F: 238PuO2 Fuel Form Facility (PuFF)
209	H B-Line
500	Works Technical: HP
501	Works Technical: Laboratories
601	Works Engineering: Electrical & Instrumentation (E&I)
911	Technical: Separations Chemistry
918	Technical: Mechanical Services (LOSD)

The Team analyzed 25 records from the CATI Set in which claimants had employment for some period between 1973 and 1981, and for which each claimant indicated work at some point at 235-F. A CATI did not always mention the specific years the claimant worked in 235-F; none of the claimants indicated they worked only at 235-F. For these workers, the Team identified HPA and HPD codes for each year for which the claimant had verified SRS employment. Table F4-4 presents a summary of the findings. HPA codes and HPD codes (in parenthesis) are shown for each year. The designation NA indicates the claimant did not have verified employment during that year. The Team checked each calendar quarter for each worker. Multiple HPA and HPD codes were identified for some claimants across quarters. Each set of HPA and HPD codes are provided in the table. Bolded code values designate areas with facilities where routine exposures to neptunium were plausible.

Table F4-4.

CATI Set Number	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	7E (703)	7E (703)	7E (703) 7F (703) **5G** (703)	7F (373)	7F (373)	7F (373)	7F (373)	7F (373)	7F (373)
2	NA	**7A** (040)	**7A** (040)	NA	NA	NA	NA	**7A** (040)	**7A** (040) **2H** (040)
4	**7A** (040)	**7A** (040)	**2F** (040)	**2F** (040)	4H **(040)**	4H **(040)**	4H **(040)**	4H **(040)**	4H **(040)**
6	1K (500)	1K (500)	1K (500)	1K (500)	1K (500)	1K (500)	1K (500) 1P (500)	1P (500)	1P (500) 1L (500)
7	6A (604) **5A** (604)	7M (604)	7M (604)	2A (604) 3A (604)	3A (604)	3A (604) 9A (604)	9A (604)	9A (604)	9A (604)
11	**2H** (800)	**2H** (800)	**2H** (800)	**2H** (800) **2F** (800)	**2H** (800)	**2F** (800) 1K (800)	1K (800)	1K (800)	1K (800)
14	NA	4D (700) **5A** (906)	**5A** (906)	**5A** (906)	**5A** (906)	**5A** (906)	**5A** (906)	**5A** (906)	**5A** (906)
19	NA[1]	NA	NA	NA	NA	**7A** (040)	**7A** (040)	**7A** (040)	**7A** (040)
21	NA	NA	NA	**7A** (040)	**7A** (040)	**7A** (040)	**7A** (040)	**7A** (040) **2H** (040)	**2H** (040)
28	**2F** (500)	**2F** (ND) 3A (700) **2F** (200)	**2F** (200) **2H** (800)	**2H** (800) 7I (800)	7I (800)	7I (800)	NA	NA	NA
31	NA	NA	**7A** (040)	**7A** (040) **5A** (040)	**5A** (040)	NA	NA	NA	**2F** (040)
37	**2F** (800)	**2F** (800)	**2F** (800)	**2F** (800)	**2F** (800)	**2F** (800)	**2F** (800)	**2F** (800)	**2F** (800)
40	**2F** (500)	**2F** (500)	**2F** (500)	**2F** (500)	**2F** (500)	**2F** (500)	**2F** (500)	**2F** (500)	**2F** (500)
50	**2H** (205)	**2H** (209)	**2H** (209)	**2H** (209)	**2H** (209)	**2F** (205) **2H** (209)	**2F** (205) **2H** (209)	**2H** (209) **2F** (201)	**2H** (200) **2H** (203)
51	**3M** (505)	**3M** (505)	**3M** (505)	**3M** (505)	**3M** (505)	**3M** (505) **3M** (205)	**3M** (205)	**3M** (205)	**3M** (205)
53	7K (601)	7K (601)	7K (601)	7K (601)	7K (601)	7K (601) 1C (601)	1C (601) 9A (604)	9A (604)	9A (604)
77	NA	NA	NA	NA	NA	**7C** (040)	**7C** (040)	**7C** (040)	**7C** (040)

CATI Set Number	1973	1974	1975	1976	1977	1978	1979	1980	1981
78	NA	NA	NA	**5G** (703)	**5G** (703) **2F** (200) **2H** (203)	**2F** (205)	**2F** (205)	**2F** (205)	**2F** (205) **5A** (918)
83	**5G (703)**	**5G** (703) **2F** (801)	**2F** (801)	**2F** (801) 4D (801) **2F** (602)	**2F** (602)	**2F** (602)	**2F** (602)	7F (602)	7F (602)
84	**2F** (202)	**2F** (202) **2F (200)**	**2F** (200) **2F** (601)	**2F** (601)	2G (601) **2F (601)**	**2F** (601)	**2F** (601)	**2F** (601)	**2F (601)**
87	**2F** (500)	**2F** (500)	**2F** (500)	**2F** (500)	**2F** (500)	**2F** (500)	**2F** (500)	1K (500)	1K (500)
99	**3M** (505)	**3M** (505)	**3M** (505)	**3M** (505)	**3M** (505)	**3M** (505)	**3M** (505)	**3M** (505)	**3M** (505)
101	NA	NA	NA	NA	NA	NA	no data found	**2F** (205) **2F** (201)	**2F** (201)
106	NA	NA	NA	1K (702)	**5G** (703)	4D (602)	4D (602)	4D (602)	4D (602)
107	NA	NA	NA	NA	NA	NA	NA	NA	3A (700) **2H** (700)

[1]NA = Not Applicable (i.e., not employed).

In summary, the team identified HPA codes for: (1) all claimants in the Intake Set identified as having known exposures; and (2) all claimants in the CATI set those identified as having worked in Building 235-F.

SC&A Finding 5: *From 1973 to 1981, the primary external dosimetry record format is from HPRED. SC&A observed that some dosimetry cycles appeared to be missing for this period. Based on a review of the 78 claimant monitoring records with employment during this period, it is apparent that dosimetry cycles without a positive external dose recorded are not reported by HPRED. Only 14% of the reviewed claims had dosimetry cycle reports for each relevant monitoring cycle. For these claims, every dosimetry entry for these workers contained a positive result.*

ORAUT Response: DOE supplies external dose reports for SRS claimants from HPRED, HPAREH, PRORAD, and quarterly and cycle external dosimetry reports. Using five rows selected from Table F4-4 above, quarterly dosimetry summaries and dosimetry cycle summaries, the Team searched for HPA codes for each cycle and determined if the cycle values matched the HPA values by quarter. Table F5-1 provides the results of the evaluation.

Table F5-1.

CATI Set Number	Year	Q1	Q2	Q3	Q4	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
1	1975	7E	7E	7F	**5G**	NR[1]	NR	7E	7E	7E	7E	7E	7E	7E	7F	7F	**5G**
28	1974	**2F**	3A	3A	**2F**	**2F**	**2F**	**2F**	**2F**	**2F**	3A	3A	3A	3A	3A	**2F**	**2F**
53	1979	1C	1C	9A	9A	NR	NR	1C	1C	1C	1C	1C	1C	9A	9A	9A	9A
78	1977	**5G**	**5G**	**2F**	**2H**	NR	NR	NR	NR	NR	NR	NR	**5G**	**2F**	**2F**	**2F**	**2H**
83	1976	4D	**2F**	**2F**	**2F**	NR	NR	4D	4D	**2F**	**2F**	**2F**	**2F**	**2F**	**2F**	**2F**	**2F**

[1]NR = Not Recorded.

For each of the five rows, each HPA value listed in cycles 1 through 12 was also listed in one of the four quarters. Since quarter summary HPA values generally match cycle HPA, the Team intends to use the quarter HPA value for any quarter where all three cycles are null, or in the absence of cycle data. Only one qualifying HPA value in any one cycle in a year is needed to qualify as a neptunium worker. Neptunium doses will be assigned on an annual basis. Workers with a qualifying HPA in just one of four calendar quarters will be assigned neptunium co-worker doses for that calendar year. With number 78 from Table F5-1, the quarterly summaries for the first and second quarter show an HPA code though there is no recorded dose for cycles in those quarters. That same worker was assigned HPA code of 5G in the last quarter of the preceding year, 1976. In this case, since a qualifying HPA code for neptunium work was assigned to the worker, the worker would be assigned neptunium dose even without external dose.

SC&A Finding 6: *For the period from January 1973 to December 1981, SC&A found no evidence that multiple HPA codes were being assigned during a given badging cycle that would allow for identifying worker movement among different work areas. Unlike the previous period, it does not appear the dosimetry department was using the HPA codes to track all worker movements during a given badging cycle.*

ORAUT Response: An examination of results provided in Tables F4-1, F4-4, and F5-1 show that HPA codes were considered over a cycle and quarter. Most DuPont workers worked in routinely-assigned areas doing routine tasks. At times some workers, including engineers and reactor workers, would need to visit areas temporarily not routinely assigned (e.g., Row 19 in Table F4-1). In that case, a reactor worker had entered a canyon without respiratory protection. The worker was exposed only to plutonium, not neptunium. Workers were monitored by Health Physics when such incidents occurred.

Neptunium doses will be assigned on an annual basis even for those workers with a single HPA code associated to the neptunium production areas within the year. With the exception of construction workers, a worker from an area not included in the list of HPA codes associated with neptunium production, and with a casual entry to an area known to have processed neptunium, would not be assigned neptunium co-worker dose; instead, dose would be assigned based on the worker's reported bioassay and in vivo results.

Furthermore, the intent of ORAUT 2017 is to define all construction workers in HP Department 040 (i.e., those working through Central Shops and trade workers) as neptunium workers. Corresponding HPA codes for the period are: 1A, 3F, 5F, 5H, 6H, 7A, 7J, 7K, 7N and 7Q, 7R, 7T, 8A, 8B, 8C, 8H, 8I, 8M, 8P, 8S, 8T, 8K and 8L (DuPont Unknown).

SC&A Observation 7: *Beginning in January 1982 and ending in December 1988, all listed HPRED dose entries contain an associated area (HPA) code. No HPD codes were identified in the HPRED dosimetry records.*

ORAUT Response: Although they may have not been propagated through HPRED, worker HPA and HPD codes are found in monthly and quarterly dosimetry reports during this period. HPD code values were identified for all sixteen worker-date combinations for time period in the Intake Set. Results are given on Table O7-1 below.

Table O7-1.

Intake Set Number	Date	HP AREA	HP DEPT	Source
32	2/18/1982	2H	500	DuPont 1982a
32	8/4/1982	2H	500	DuPont 1982b
48	10/31/1983	2H	203	DuPont 1984a
76	9/23/1983	2H	960	DuPont 1983b
121	1/8/1982	2H	500	DuPont 1982a
124	6/7/1984	2F	501	DuPont 1984a
128	11/19/1985	2F	200	DuPont 1986
142	1/19/1982	2F	501	DuPont 1982a
142	4/26/1982	2F	501	DuPont 1982c
142	9/1/1982	2F	501	DuPont 1982b
142	6/20/1988	2F	571	DuPont 1988a
143	8/9/1988	5A	969	DuPont 1988b
148	2/16/1988	2F	500	DuPont 1988c
160	10/21/1988	7A	40	DuPont 1989
185	1/12/1983	2F	501	DuPont 1983a

SC&A Finding 7: *For 1982 to 1988, the primary external dosimetry record format is from HPRED. SC&A observed that some dosimetry cycles appeared to be missing during the period. Based on a review of the 77 claimant monitoring records with employment during this period, it appears that dosimetry cycles without a positive external dose recorded are not reported by HPRED. Only 5% of the reviewed claims had dosimetry cycle reports for each relevant monitoring period, and every dosimetry entry for these workers contained a positive result.*

ORAUT Response: Although the results may not have been entered into HPRED, during this time period site dosimetry reports list the roll, employee number, HP Area (HPA), Date Badged, HP Department (HPD), and employee name even where there were no associated positive results for each of these worker-date combinations.

From the Intake Set, 16 worker-date combinations were found to have dates between January 1, 1982 and December 31, 1988. An HPA code was identified for each using the site dosimetry reports, as given in Table O7-1.

SC&A Finding 8: *For the period from January 1982 to December 1988, SC&A found no evidence that multiple HPA codes were being assigned during a given badging cycle, which would allow for identifying worker movement among different work areas. It is apparent that the dosimetry department was not using the HPA codes to track worker movements during a given badging cycle.*

ORAUT Response: The Team analyzed 25 records from the CATI Set in which claimants had employment of at least three years during the period between 1972 and 1989, and for which each claimant indicated work at some point at 235-F. A CATI did not always mention specific years the claimant worked in 235-F; none of the claimants indicated they worked only at 235-F. For these workers, the Team identified HPA and HPD codes for each year for which the claimant had verified SRS employment. Table F8-1 presents a summary of the findings. HPA codes and HPD codes (in parenthesis) are shown for each year. The designation NA indicates claimant did not have verified employment during that year. The Team checked each calendar quarter for each worker. Multiple HPA and HPD codes were identified for some claimants across quarters. Each set of HPA and HPD codes are provided in the table. Bolded code values designate areas with facilities where routine exposures to neptunium were plausible.

Table F8-1.

CATI Set Number	1982	1983	1984	1985	1986	1987	1988
7	9A (604)	9A (604)	9A (604)	9A (604)	9A (604)	9A (604)	9A (604)
11	1K (800)	1P (180) 1P (180) 7I (602) 7I (162)	1C (162) 7I (162) 7I (164)	1C (164)	1C (164)	1C (164)	1C (164)
14	**5A** (906) **5A** (950)	**5A** (961)	**5A** (961)	**5A (961)**	**5A** (961)	**5A** (958)	**5A** (958)
21	**7A** (040) 1L (040)	1L (040) 4H (400)	4H (400)	4H (400)	**6H** (400)	**6H** (400)	**6H** (400)
28	4D (602)	4D (602)	4D (602) 4D (162)	4D (162) 4D (166)	4D (166)	4D (166) 4D (606)	4D (606) 4D (764)
31	**2F (040)**	**2F (040)**	**2F** (040) 3F (040) **5F** (040)	**2F** (040) **5F** (040) 3F (040)	**2F** (040) **3M** (040)	**3M** (040) **7R** (040)	**7R** (040)
33	NA	1P (104)	7W (057)	7W (057)	7W (057) 6W (057)	6W (057)	6W (057)
35	**7G** (601)	**7G** (601)	**7G** (601) **7K** (601) **7Q** (603)	**7Q** (606)	**7Q** (606)	**7Q** (606)	**7Q** (606)
40	**2F** (500)	**2F** (500) **2F** (520)	**2F** (520) **2F** (500)	**2F (500)**	**2F** (522)	**2F** (522) **2F** (554)	**2F** (522)
49	NA	NA	**7A** (040)	**7A** (040)	6F (040)	**6H** (040)	**6H** (040)

CATI Set Number	1982	1983	1984	1985	1986	1987	1988
50	**2H** (203) **2H** (209)	**2H** (209) **2H** (203) **2H** (281)	**2H** (261) **2H** (281)	**2H** (281)	**2H** (204)	**2H** (204)	**2H** (209)
51	**3M** (505)	**3M** (505)	**3M** (505) **3M** (300)	**3M** (225)	6F (255)	6F (255)	6F (255)
53	9A (604) **2F** (210)	**2F** (261)	**2F** (280)	**2F** (280)	**2F** (280)	**2F** (280)	**2F** (280)
61	NA	NA	NA	NA	6W (057)	**2F** (057)	**2F** (057)
74	NA	NA	NA	**2F** (057)	**2F** (057)	**2F** (057)	**2F** (057) IL (057)
77	**7A** (040) **7R** (040)	**7R** (040)	**7R** (040)	**7R** (040)	**7R** (040) **7C** (040)	**7R** (040)	1L (508)
78	**5A** (518) **5A** (955) 5D (955)	5D (955)	5D (601) **2H** (604) **2H** (420)	**2H** (604)	**2H** (604) **2H** (700)	**2H** (700)	**2H** (700)
83	5B (506) 1C (100)	5B (506)	**7G** (602)	**7G** (602)	**7G** (602)	**7G** (602)	**7G** (602)
87	1K (500)	1K (500)	1K (500)	1K (500)	1K (500)	1K (500)	1K (500) C01 (500)
90	**2H** (603)	**2H** (603)	**2H** (603)	**2H** (603)	**2H** (603)	**2H** (603)	NA
99	**3M (505)**	**3M (505)**	**3M** (505) 4D (800) **5G** (704)	**5G** (704) 6A (800)	6A (800, 900)	6A (900)	6A (900)
101	**2F** (201)	**2F** (201)	**2F** (201) 3A (606)	3A (606)	3A (606)	3A (606)	3A (606)
104	NA[1]	NA	NA	3A (166) 3A (500)	3A **(**585) **2F** (585) **2F** (520)	**2F** (520) **2H** (520) 4F (500) 4F (585)	4F (500) 4F (525) 4F (585)
106	4D (602)	4D (602) **7N** (602)	**7N** (602) **7N** (606)	**7N** (606)	**7N** (606)	NA	NA
107	**2H** (700) 1C (105)	1C (105)	1C (105)	1C (105) 1K (161)	1K (161)	1K (161) 1C (870)	1K (161)

[1]NA – not applicable – not employed.

The majority of workers did not move between areas within a badging period. For construction workers in HP Department 040 who may have worked in multiple areas within a given badge period, an assumption is made to treat them as neptunium workers. Other workers who may have had a casual entry into a neptunium production area and not found to have an HPA code associated with neptunium production would not be assigned neptunium co-worker dose, but instead, would be assigned dose based on the worker's reported bioassay.

SC&A Observation 8: *Dosimetry record keeping appears to go through a transition in 1989. Dosimetry cycles generally were not reported in HPRED until April of that year, and HPA codes are not included until July. In addition, zero dose cycles were reported and multiple HPA codes can be observed for the same dosimetry cycle.*

ORAUT Response: From the response to Finding 1, the Team was able to find HPA codes for dosimeter assignments SC&A could not locate. In the case of Figure 12 in SC&A 2017, two dosimeter assignments were made for the worker in cycle #7 (quarter 3). The second HPA of F06 designated Navy Fuels. Radiation exposures from that facility were tracked separately from other SRS work so a new dosimeter was assigned during the cycle. In the case of multiple HPA codes in a cycle, all will be captured per the example instructions given in response to Observation 1.

SC&A Observation 9*: For the 1990–2000 period, SC&A observed that dosimetry dose cycles with no positive exposure were included in the HPRED printouts. SC&A also saw evidence that multiple HPA codes were assigned to the same dosimetry cycle. SC&A's examination of 55 reviewed claims during this period indicates that about 93% of the reviewed case files had complete dosimetry records. The four remaining claims were closely examined, and SC&A believes there are plausible explanations for what appear to be gaps in the dosimetry monitoring (i.e., the EE did not require monitoring).*

ORAUT Response: Observation noted.

SUMMARY

The Team was able to find HPA codes for those unmatched in the Intake Set by SC&A using data supplied for the claimant and using SRS dosimetry reports obtained from SRS. The Team was also able to find HPA codes for all randomly selected claims from the NOCTS Set from 1973 through 1995.

The Team was also able to find HPD codes for all randomly-selected claims from the NOCTS Set from 1973 through the first quarter 1989. Although the majority of HPD values identified in the Intake Set were those cited in NIOSH 2017 Section 8 [205, 500, 503, 209, 300, 601], both SC&A and the Team identified additional HPD codes from that set. The Team also identified additional codes from the NOCTS Set. The HPA code 040 (Construction Department) was identified in both sets. The Intake Set is a closer representation of actual workers exposed to Np-237 than those the NOCTS Set; however, data are not available to narrow that set beyond the use of HPA codes for areas known to routinely process neptunium. HPD codes are not readily available for SRS claimants for work period of mid-1989 forward.

In the next revision to the technical basis documents for SRS, language will be added to address Observation 5, Observation 6, Finding 2, and Finding 3 to state that where DOE has not provided the biweekly and monthly badge reports, these may be found in SRDB. These exposure documents contain HPA codes and are linked to the claimant by name during the SRDB document review process.

The Team will use the HPA codes given in Table S-1 below to identify claimants with the potential for routine exposure to neptunium, and for which neptunium co-worker doses will be applied. The Team will not use HPD codes to determine claims to assign neptunium co-worker dose.

Table S-1. Applicable HPA Codes by Time Period.

HPA Code	Comment	Time Period
2F	200-F Area	1973-1989
1A	200-F Area	1973-1980
5F	235-F Construction Gate	1973-1989
2H	200-H Area	1973-1989
4H	200-H Tritium Area[1]	1973-1983
5H	200-H South Construction Gate	1973-1989
6H	200-H North Construction Gate	1973-1989
3M	300-M Area	1973-1989
5A	773-A	1973-1989
1A	773-A Construction Gate	1980-1989
7A	Central Shops South Gate	1973-1989
7R	Central Shops North Gate	1973-1989
5G	705-G T&T	1973-1989
7G	717-A Maintenance	1973-1989
7J	Iron worker	1973-1989
7K	722-A E&I	1973-1989
7N	725-A Maintenance	1973-1989
7Q	722-4A E&I	1973-1989
7T	Diversco	1980-1989
7C	TC?	1973-1989
8A	Machinist	1980-1989
8B	Boilermaker	1980-1989
8C	Carpenter	1980-1989
8D	Heavy Equipment Operator	1980-1989
8I	Insulator	1980-1989
8K	Concrete worker	1980-1989
8L	Laborer	1980-1989
8M	Millwright	1980-1989
8P	Painter	1980-1989
8S	Sheet metal	1980-1989
8T	Transportation	1980-1989

[1]HPA 4H is generally associated with tritium facilities workers, but replacement workers were rotated to 235-F from the tritium area when external exposures of neptunium workers approached the administrative limit (ORAU 2013).

Dose reconstructors will use a process similar to the following steps to identify claimants to assign neptunium co-worker dose:

1. When working on external dose reconstruction, the DR will input the HPA value for each dosimeter cycle/quarter, as reported by DOE. In the 1970s, SRS generally reported dose by quarter showing in the last cycle of a quarter.

2. The DR will retrieve and input the HPA code for any missing cycle/quarter.

3. The DR will complete the external dose reconstruction.

4. Moving to internal dose reconstruction, the DR will use the neptunium dose tool (Table O1-1). The DR will review the HPA codes entered by cycle by year entered in the external dose tool. Using the list of HPA codes given in Table S-1, the DR will review the captured HPA codes by year. Only one HPA code from Table S-1 is needed for a particular year.

5. The DR will input a qualifying HPA code in the neptunium dose tool for the year and move to the next year. The DR will leave the HPA field blank for any year for which no qualifying HPA code was captured in the external dose tool for that year.

6. The DR will use actual neptunium bioassay and neptunium in vivo results when available to reconstruct neptunium dose.

7. For periods where a claimant was not monitored for neptunium, the DR will assign neptunium dose by year for all years with a value entered in the HPA field in the neptunium dose field.

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