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Evaluation of Monitoring of Construction Workers Identified in High-Level Cave Job Plans at the Savannah River Site

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PUBLICATION RECORD

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06/27/2017	00	New report for the evaluation of monitoring of construction workers identified in high-level cave Job Plans at the Savannah River Site. Incorporates formal internal and NIOSH review comments. Training required: As determined by the Objective Manager. Initiated by James M. Mahathy.

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ACRONYMS AND ABBREVIATIONS

cm	centimeter
CTW	construction trade worker
DOE	U.S. Department of Energy
dpm	disintegrations per minute
EU	enriched uranium
HLC	high-level caves
HLD	high-level drain
HP	Health Physics Department
HVAC	heating, ventilation and air conditioning
ILC	intermediate level cave
in.	inch
L	liter
MCC	motor control center
NIOSH	National Institute for Occupational Safety and Health
ORAU	Oak Ridge Associated Universities
PRID	Payroll Identification (number)
RSL	Radiation Survey Logsheet
SRDB Ref ID	Site Research Database Reference Identification (number)
SRS	Savannah River Site
SWP	Special Work Permit
α	alpha particle
µCi	microcurie

1.0 INTRODUCTION

This report addresses if Savannah River Site (SRS) subcontracted construction trade workers (CTWs) were monitored differently from prime contractor (DuPont) CTWs when doing the same types of work during the 1980s. The Oak Ridge Associated Universities (ORAU) Team reviewed SRS documents to evaluate radiological monitoring of subcontractor CTWs compared to DuPont CTWs.

ORAUT-OTIB-0081, *Internal Coworker Dosimetry for the Savannah River Site* (ORAUT 2016), describes a method to allow the identification of CTWs using a site-applied identifier, specifically the SRS Payroll Identification (PRID) number. The PRID contained a prefix letter or number for the type of worker payroll referred to as Roll, an optional two-digit code for craft, and a 4- or 5-digit badge number. Roll prefixes changed over time. Rolls T, 0, and 1 designated DuPont salaried employees. Roll 2 designated local operations hourly workers. Roll 3 designated Wilmington CTWs (engineering and support workers). Roll 4 designated non-DuPont local hourly workers, most of whom were CTWs. Non-DuPont workers other than subcontractor CTWs were tracked in Roll 5. Over time, some non-DuPont CTWs were added to Roll 5. In 1985, Roll 6 was added for CTWs (DuPont 1954, ca. 1961, 1981a, 1988; WSRC 1990a). The ORAU Team noted TR and TB prefixes were used for certain temporary workers and the PS prefix that was used for employees of Diversco (DuPont 1983–1985).

Monitoring of workers at SRS was accomplished through the use of procedures and building safety plans. For certain short-term tasks, typical of CTW activities, SRS used Job Plans and Special Work Permits (SWPs). In special circumstances, work clearance permits and confined space logs were also used. Thus, the following forms associated with these plans, permits, or logs were reviewed for this report:

- Job Plan,
- SWP,
- Work Clearance Permit, and
- Confined Space or Vessel Entry Log.

Attachment A provides examples of each. Each form described the planned activity, documented the monitoring and exposure control requirements, and had sections to list the names of the assigned workers under that plan or permit.

2.0 IDENTIFICATION OF WORKERS

In June 2016, the ORAU Team obtained several hundred Job Plans and safety permits for work at the high-level caves (HLCs) in Building 773-A between October 1979 and December 31, 1986. These Job Plans and safety permits are grouped by year. Table 2-1 provides the date ranges and associated references for the 21 documents that contain these forms. The coverage of Job Plans over the period under evaluation is shown in the timeline in Figure 2-1. Green indicates the range of dates covered by Job Plan files while the color red indicates Job Plan files not found for those dates. The Job Plan files listed in Table 2-1 are not necessarily all of the Job Plans used at the HLC during the period. Using the method described in ORAUT-OTIB-0081, *Internal Coworker Dosimetry for the Savannah River Site* (ORAUT 2016), the ORAU Team reviewed the job plan forms and extracted the names and PRID numbers of CTWs. Identified workers were sorted by employment (i.e., DuPont or subcontractor) and by year. The Team then reviewed each Job Plan and work permit chronologically to identify CTWs from Roll 2 (DuPont CTWs) and from Rolls 4, 5, and 6 (subcontractor CTWs).

Table 2-1. Job Plans by date.

Date	Reference
10/25/1979–07/08/1981	DuPont 1981a
01/02/1980–04/30/1980	DuPont 1980a
05/01/1980–09/30/1980	DuPont 1980b
10/01/1980–12/31/1980	DuPont 1980c
01/05/1981–04/30/1981	DuPont 1981b
05/01/1981–09/30/1981	DuPont 1981c, 1985a
10/01/1981–12/30/1981	DuPont 1981d
01/05/1982–04/30/1982	DuPont 1982a, 1985a
05/01/1982–08/31/1982	DuPont 1982b, 1985a
09/01/1982–12/29/1982	DuPont 1982c
01/03/1983–05/31/1983	DuPont 1983a
06/02/1983–08/31/1983	DuPont 1983b
09/01/1983–12/29/1983	DuPont 1983c
01/05/1984–04/30/1984	DuPont 1984a
05/01/1984–08/30/1984	DuPont 1984b
09/01/1984–12/31/1984	DuPont 1984c
01/02/1985–04/30/1985	DuPont 1985b
05/01/1985–12/17/1985	DuPont 1985c
01/02/1986–06/30/1986	DuPont 1986a
07/01/1986–12/30/1986	DuPont 1986b, 1986c

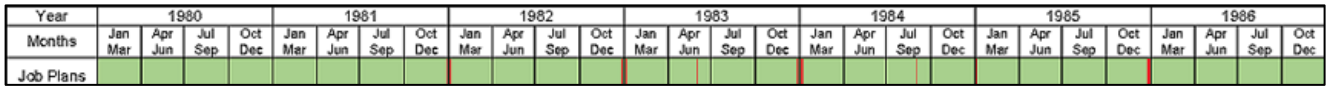


Figure 2-1. Timeline showing availability of Job Plans (green = Job Plans found; red = brief portions (days) not found).

Job Plans were used to permit all types of work and, therefore, covered all types of SRS workers. The "Done By" line of the Job Plan showed which organization was to do the work. Line 8, Procedure review with Crafts (Maint, E&I, T&T) was used to indicate work to be done by CTWs. Figure 2-2 shows these on an example Job Plan (DuPont 1982b).

The ORAU Team identified Job Plans for maintenance or construction work on which:

- Any designation indicating Maintenance, Maint, E&I, T&T, AM, Construction, or Const was written in the "Done by" box as shown in Figures 2-2 and 2-3 (DuPont 1982b, 1984a),
- Box 8 of the Job Evaluation section contained Yes regardless of the "Done by" box, or
- Neither of the above were true, but the form contained recognizable[1] CTW names in the Estimated Exposure section.

These forms were separated into a subset for further evaluation.

Workers who were listed on an SWP (Figure A-2) and its Supplementary Time Sheet page (Figure A-3) are usually subcontractor CTWs. These forms were also included in the subset for further evaluation. Names and PRIDs are recorded in the Name and Payroll Number columns as shown in Figure 2-4.

[1] The ORAU Team recognized the names of CTWs already captured during the review of job plans.

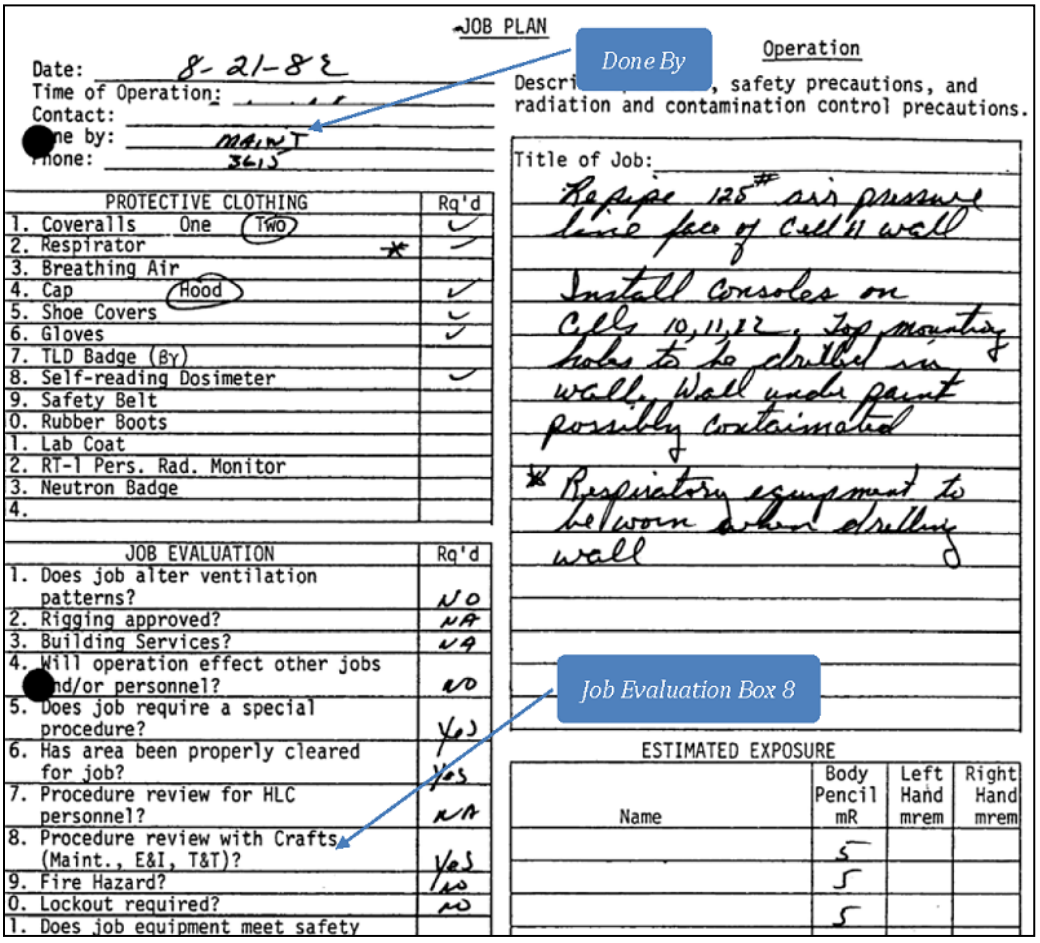


Figure 2-2. Identifiers for Job Plan (DuPont 1982b).

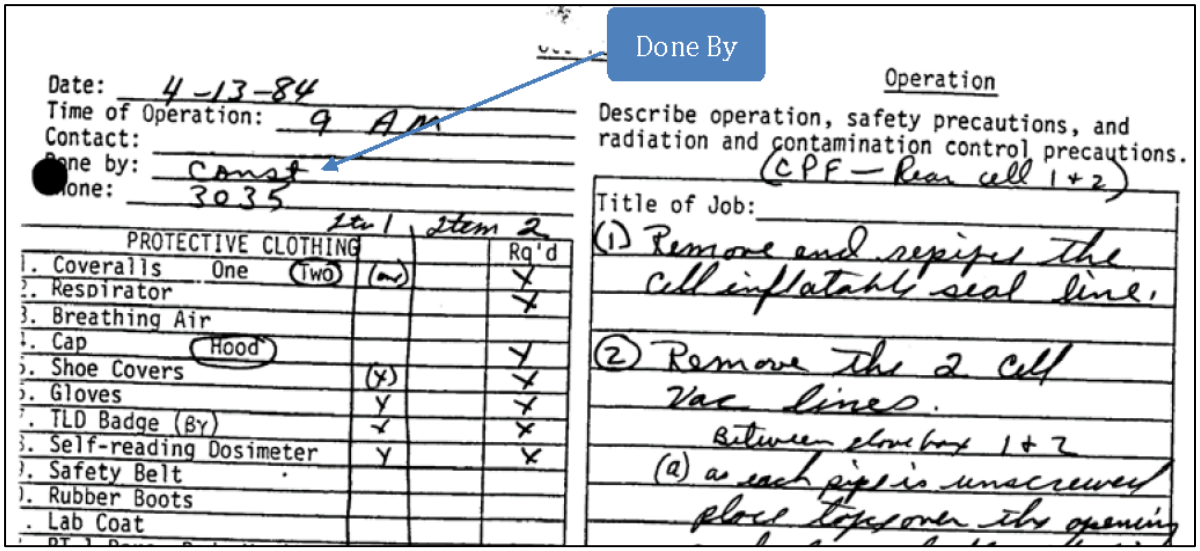


Figure 2-3. Construction identifier for Job Plan (DuPont 1984a).

Work Clearance Permits and Confined Space and Vessel Entry Logs were also included in the subset of forms for further evaluation of workers. These form types represent generally about 5% of the total forms reviewed. Examples are available in DuPont (1982a, 1983c, and 1985c).

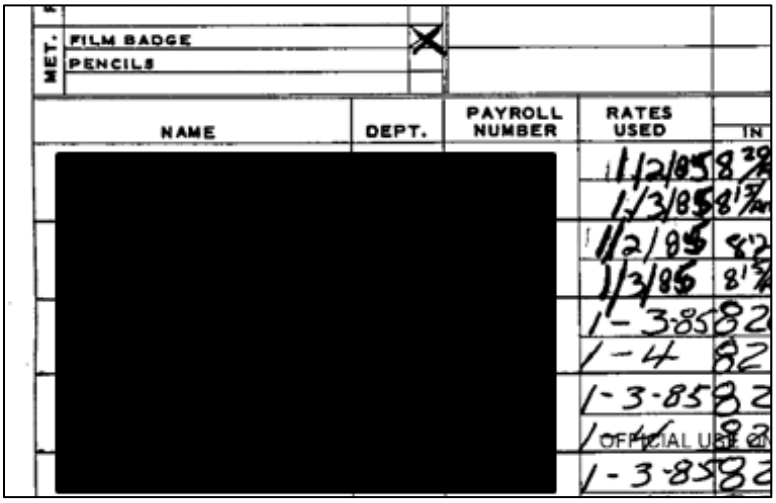


Figure 2-4. SWP Name column (DuPont 1982b).

The ORAU Team reviewed names on each form in the subset by year. A worker was included in the annual list of names if the entry had at least an initial and last name with a PRID, otherwise the entry was not considered. Names and PRIDs were handwritten, sometimes scribbled, on the forms and often were difficult to decipher. The Team compared difficult-to-read names or PRIDs to legible entries on Job Plans with similar work and departments. For example, a name on a Job Plan for maintenance in C Wing was compared to names on other Job Plans for maintenance in C Wing.

In some instances the name was not legible while the PRID was. In other instances the name was legible but not all of the PRID was legible. In both of these cases, SRS external dosimetry logs were used to assist in resolving the worker's identity. Names and PRIDs of workers in Rolls, 2, 4, 5, and 6 were recorded. Not all workers in Roll 2 were CTWs. Those not assigned to a CTW occupation were removed after evaluation using SRS job history cards.

Using the method described above, the ORAU Team identified 1,052 CTWs and was able to resolve 1,047 name and PRID combinations (99.3%). Of these, 397 were DuPont employees and 650 were subcontractors. Table 2-2 lists the number of workers by year and type. Workers were listed only once per year even though each might have worked under more than one Job Plan during a year. Some workers were found in more than 1 year.

Table 2-2. Total identified workers by year.

Year	DuPont CTW	DuPont CTW with potential for intake	Subcontractor CTW	Subcontractor CTW with potential for intake
1980	60	48	8	8
1981	47	41	82	47
1982	68	55	80	20
1983	70	43	99	57
1984	60	49	122	65
1985	49	44	172	115
1986	43	25	87	38
Totals	**397**	**305**	**650**	**350**

The Team assessed each of the Job Plans or SWPs linked to the workers' names to determine if the job potentially required or led to bioassay. For example, the Health Physics Department (HP) could require bioassay in advance of a job by marking the "Give Bioassay Sample Before Leaving" box on the SWP as shown in Figure A-2, or by writing "bioassay required" in the required monitoring text boxes on the forms. HP also indicated on Job Plans when respiratory protection would be required:

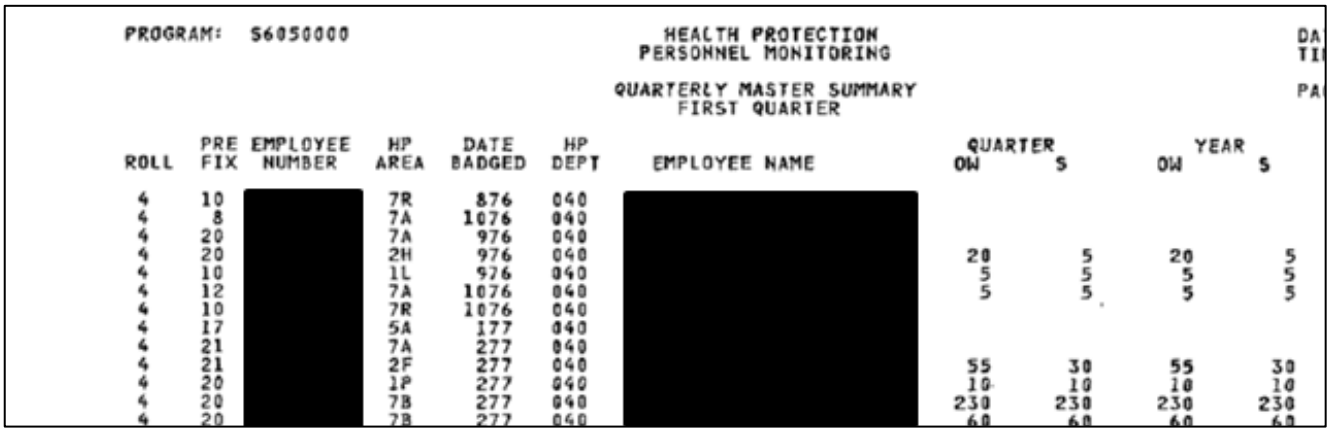
1. No potential, or
2. Potential for intake.

A worker was counted as having a potential for intake for that year if any one plan or permit contained one of the indicators described above. However, it should be noted that a worker found to have no potential for exposure in a given year could have been exposed while working at other jobs in Building 773-A or other SRS locations.

3.0 EVALUATION OF CTW EXTERNAL MONITORING

External dosimetry records were searched for each identified worker using their names and PRID numbers to determine when monitoring was performed for each. For each year, the percent of workers who were monitored was calculated for the groups DuPont CTW, subcontractor CTW, and total CTW.

Using the name, PRID data, and year, the Team searched SRS quarterly external monitoring reports for each worker to determine if the worker was monitored for external radiation at least once during the year (DuPont 1980d, 1980e, 1980f, 1981e, 1981f, 1981g, 1981h, 1982d, 1982e, 1982f, 1982g, 1983d, 1983e, 1983f, 1983g, 1984d, 1984e, 1984f, 1984g, 1985d, 1985e, 1985f, 1985g, 1986c, 1986e, 1986f, 1986g, 1987a). Figure 3-1 is a redacted sample of an external monitoring report showing subcontracted CTWs.



PROGRAM: S6050000

HEALTH PROTECTION
PERSONNEL MONITORING

QUARTERLY MASTER SUMMARY
FIRST QUARTER

ROLL	PRE FIX	EMPLOYEE NUMBER	HP AREA	DATE BADGED	HP DEPT	EMPLOYEE NAME	QUARTER DW	QUARTER S	YEAR DW	YEAR S
4	10	[redacted]	7R	876	040	[redacted]				
4	8		7A	1076	040					
4	20		7A	976	040					
4	20		2H	976	040		20	5	20	5
4	10		1L	976	040		5	5	5	5
4	12		7A	1076	040		5	5	5	5
4	10		7R	1076	040					
4	17		5A	177	040					
4	21		7A	277	040					
4	21		2F	277	040		55	30	55	30
4	20		1P	277	040		10	10	10	10
4	20		7B	277	040		230	230	230	230
4	20		7B	277	040		60	60	60	60

Figure 3-1. Quarterly external monitoring report.

Table 3-1 provides the number of externally monitored CTWs by year and employment type. All DuPont CTWs were monitored for 5 of the 7 years, while all subcontractor CTWs were monitored for 4 of the 7 years. Results of external monitoring were reported by calendar quarters. While the quarterly results are not broken down into specific work or work areas during the quarter, results by quarter covered all job plans for the quarterly period as assessed in this report .

The significant monitoring disparity in 1985 was investigated and involved 20 subcontractor CTWs in 1985 were found to have temporary badges. These electricians, pipefitters, and construction workers installed heating, ventilation. and air conditioning (HVAC) systems on the roofs of D and E Wings spanning 2 workdays in 1985 (DuPont 1985b, pp. 277–287). The Team found no records of external monitoring for these workers, although the Job Plan implies some of the workers were monitored by film badge and neutron dosimetry for a portion of the job. Two subcontractor CTWs with temporary badges were found to have installed tile in 1986 in a women's change room, E-029 (DuPont 1986b, p. 301. While there were requirements for HP monitoring of roof-HVAC work (and no permit information available for ORAU Team review associated with the women's change room tile installation), such data has not been acquired by the Team. HPs monitored each of these jobs

Table 3-1. Percent of workers with external monitoring data.[a]

Year	DuPont CTW	Percent monitored	Subcontractor CTW	Percent monitored
1980	60	100.0	8	100.0
1981	47	100.0	82	100.0
1982	67	98.5	80	100.0
1983	70	100.0	98	99.0
1984	60	100.0	122	100.0
1985	49	100.0	152	88.4
1986	41	97.7	87	97.8
Totals	**395**	**99.5**	**629**	**96.8**

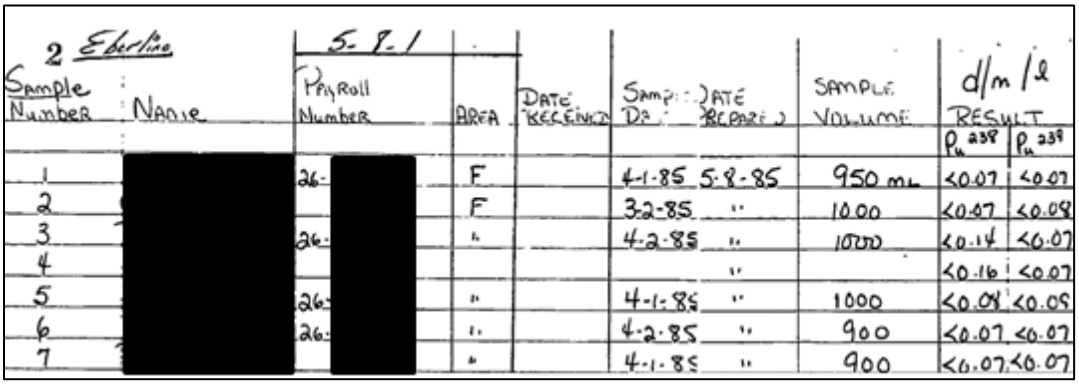
a. Sources: DuPont 1980d, 1980e, 1980f, 1981e, 1981f, 1981g, 1981h, 1982d, 1982e, 1982f, 1982g, 1983d, 1983e, 1983f, 1983g, 1984d, 1984e, 1984f, 1984g, 1985d, 1985e, 1985f, 1985g, 1986c, 1986e, 1986f, 1986g, 1987a).

intermittently. Radiation survey data of those locations and job tasks may be available at SRS. Results of air monitoring collected on the dates of these jobs in 1985 and 1986 were at background (DuPont 1985k, 1986p).

4.0 EVALUATION OF CTW INTERNAL MONITORING

The SRS routine bioassay monitoring program was based on work location with the chosen radionuclides and frequencies that HP determined from the exposure potential in each facility (ORAUT 2016). DuPont CTWs were part of that routine monitoring program in accordance with the bioassay control procedures (DuPont 1976). For other workers intermittently present in a controlled area (i.e., some subcontractor CTWs), bioassay monitoring was based on the Job Plan. In addition, HP could also request bioassay when airborne, surface, or worker contamination events and incidents were noted. With such events, incident-driven bioassay sampling was performed. Most subcontractor CTW bioassays were the result of job-based or incident-based sampling, although some subcontractor CTWs were routinely monitored for intakes of radiation.

The Team reviewed available SRS bioassay logbooks for each worker who was identified as having a potential for exposure to determine if the worker was monitored for internal radiation at least once in the year (DuPont 1980g, 1980h, 1980i, 1980j, 1980k, 1981i, 1981j, 1981k, 1981l, 1981m, 1981n, 1981o, 1982h, 1983h, 1983i, 1983j, 1984h, 1984i, 1985h, 1986i, 1986j, 1987b, 1987c, 1989; WSRC ca. 1990b). Figure 4-1 shows a redacted example of a plutonium logbook with results for a subcontracted CTW in 1985. This review did not include fission product or tritium bioassays, both of which were collected from workers who performed certain jobs at the HLCs.



2 Eberline — 5-8-1

Sample Number	Name	Payroll Number	Area	Date Receiving	Sample Date	Date Reported	Sample Volume	d/m/l Result P_u 238	P_u 239
1	[redacted]	26-[redacted]	F		4-1-85	5-8-85	950 mL	<0.07	<0.07
2			F		3-2-85	"	1000	<0.07	<0.09
3		26-	"		4-2-85	"	1000	<0.14	<0.07
4						"		<0.16	<0.07
5		26-	"		4-1-85	"	1000	<0.09	<0.09
6		26-	"		4-2-85	"	900	<0.07	<0.07
7			"		4-1-85	"	900	<0.07	<0.07

Figure 4-1. Excerpt from plutonium bioassay logbook, 1985.

The Team found no bioassay results for 550 subcontractor CTW-job pairings (255 unique subcontractor workers). To evaluate bioassay of subcontractor CTWs, the Team performed an

analysis of these subcontractor CTW-job pairings. The Team originally randomly selected 10 workers from the 255 subcontractors to evaluate with the intent of collecting their personal monitoring data during an SRS data capture. An additional 100 workers were later randomly selected from those 255 subcontractor CTWs to retrieve bioassay results for further evaluation. Some workers were paired with jobs in multiple years, which resulted in 133 distinct subcontractor CTW-job pairings with no bioassay records. Table 4-1 gives the distribution of the selected 133 subcontractor CTW-job pairings with no bioassay records by year.

Table 4-1. Number of subcontractor CTW-job pairings by year.

Year	All subcontractor CTW-job pairings	Subcontractor CTW-job pairings where respirators are required
1980–1981	19	18
1982–1983	26	20
1984	29	11
1985	43	23
1986	16	16
Totals	**133**	**88**

In November 2016, the Team performed a data capture at SRS to search for bioassay data for the 110 CTWs for the given years. The data was separated by year and by job and by exposure potential. Crafts represented by the 110 randomly selected workers included boilermaker, carpenter, concrete worker, construction, driver, electrician, heavy equipment operator, ironworker, laborer, millwright, painter, pipefitter, radiographer, and sheet metal worker. Because of the few number of data points for 1980 and 1982, data for 1980-1981 and 1982-1983 were combined. The distribution of crafts is shown graphically in Figure 4-2 (DuPont 1981a, 1980a, 1980b, 1980c, 1981b, 1981c, 1985a, 1981d, 1982a, 1985a, 1982b, 1982c, 1983a, 1983b, 1983c, 1984a, 1984b, 1984c, 1985b, 1985c, 1986a, 1986b, 1986c).

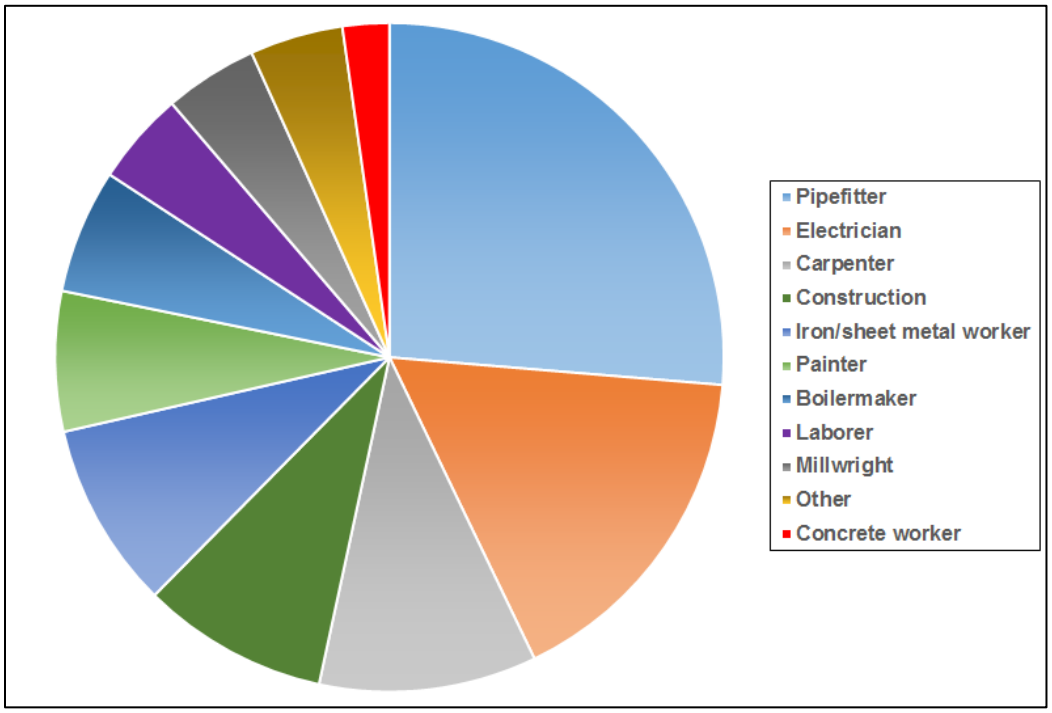


Figure 4-2. Crafts identified in Job Plans used for evaluation of bioassay monitoring.

During the data capture, the Team found bioassay data for 105 of the 110 workers (ORAUT 2017). For each of the 110 workers, the tasks described on the Job Plans were reviewed. For workers who appeared on more than one Job Plan in the same year, a task was selected that appeared to have provided the greatest risk of internal exposure for the worker. Tasks performed under Job Plans and permits reviewed for this report represent only a small portion of work done by most of the subcontractor CTWs. Certain subcontractor CTWs are likely to have been sampled in relation to work in other SRS areas during the same year as the year of the reviewed Job Plan or permit at Building 773-A, or as part of routine bioassay. SRS ran a plantwide bioassay program. Results of bioassay obtained in other areas is still under evaluation for use in reconstructing doses from work in Building 773-A.

- These 773-A Job Plans were reviewed for:
    - Craft;
    - Date of the Job Plan;
    - Task description and location;
    - Type of monitoring (at the start, intermittent, or continuous);
    - If respiratory protection was required;
    - Results of alpha or fission product continuous air sampling for the location on the date of the work; and
    - Dates of collection of in vitro bioassay samples and dates of in vivo bioassay measurements.

Attachment B, Table B-1 provides the results of these reviews. Each row in the table represents a single worker in a single year. Note that no identifying information is shown and some workers appear in this table in multiple years, which results in a total of 133 rows.

Bioassay results available for a worker were examined based on the time between the date of the job and the date of sampling with the time difference compared to bioassay frequencies given in DuPont 1971. A worker was marked as being sampled for a particular radionuclide if the sampling time difference was less than or equal to the frequency given for the radionuclide.

- Workers with potential for intakes of plutonium in Building 773-A were sampled once every three years by plutonium urinalysis or chest counting (DuPont 1971).
- Workers with potential for intakes of fission products in Building 773-A were sampled by fission product urinalysis or whole-body counting annually (DuPont 1971).
- Workers with potential for intakes of americium in Building 773-A were sampled by americium urinalysis every six months (DuPont 1971).

In addition to these checks based on bioassay frequencies, two additional checks were made:

- Workers with results from tritium bioassay collected at 773-A or A Area up to 2 months from date of work were noted as having tritium bioassay.
- Workers with results of bioassay from any other radionuclide, such as enriched uranium, within 1 year from the date of task were noted as having bioassay for that radionuclide.

The Team also:

- Identified workers with results of plutonium bioassay collected within one year of the date of job.

- Identified routine bioassay results for plutonium and fission products that indicated a subcontractor CTW was on routine bioassay.

Of the 133 worker-job pairings, 88 required the use of respiratory protection. Table 4-1 shows the number of worker-job pair pairings by year.

While the Team found bioassay results for some workers that were not required by a Job Plan to use respiratory protection, the Team focused on the 88 subcontractor CTW-job pairings where workers were required to use respiratory protection. Table 4-2 lists summary data for these reviews by year. The total number with bioassay represent the number of workers with actual bioassay results (plutonium, americium, fission product or, rarely, tritium) within the above periods.

Table 4-2. Summary of subcontractor CTW bioassay monitoring by year.

Period	Potentially exposed subcontractor CTW-job pairings with bioassay	Potentially exposed subcontractor CTW-job pairings with bioassay%	Subcontractor CTW on routine bioassay
1980–1981	11	61.1	6
1982–1983	12	60.0	8
1984	6	54.5	5
1985	18	78.3	11
1986	12	75.0	4
Totals	**59**	**67.0**	**34**

The percentage of subcontractor CTWs from the sample of 88 subcontractor CTW-job pairings monitored by bioassay ranged from 54.5% in 1984 to 78.3% in 1985. Thirty-four of the 88 subcontractor CTWs, or about 39%, using respiratory protection were on SRS routine monitoring at the time of the Job Plan. HPs monitored jobs requiring respiratory protection. By procedure they would require bioassay from subcontractor CTWs after such jobs depending on results of air monitoring or whether incidents occurred (DuPont 1976). Examples of the latter are given in Section 6.0. Figure 4-3 depicts the numbers of workers monitored by bioassay as presented in Table 4-2. The total number of subcontractor CTW is shown in red while the total workers with bioassay is shown in blue. The total number of subcontractor CTW on routine bioassay is shown in green (DuPont 1980h, 1980i, 1980k, 1980g, 1981k, 1981j, 1980j, 1981i, 1981l, 1981m, 1981n, 1983h, 1983i, 1983j, 1984h, 1984i, 1985h, 1986h, 1986i, 1989; ORAUT 1987b, 1987c, 2017; WSRC ca. 1990c).

Workers on short-duration jobs (less than a few days) were not likely to have been sampled unless an incident in the associated work area led to an incident bioassay. The Team found bioassay results of coworkers on the same Job Plans for another 26% of the subcontractor CTWs using respiratory protection, although it is possible that the coworker bioassay was collected as a result of work on a different job or work location. The Team identified temporary workers with bioassay (DuPont 1984i, p. 165; 1968, p. 38; 1985h, pp. 118, 120; ORAUT 1989a, pp. 136, 138, 150) including one who was sampled after an incident (DuPont 1987d, p. 122).

5.0 EVALUATION OF WORKPLACE JOB MONITORING

All work locations in Building 773-A were surveyed and swiped for contamination on routine, defined frequencies. Airborne environments of work locations were continuously monitored for alpha and beta-gamma radioactivity (DuPont 1982i, 1982j, 1983k, 1983l, 1983m, 1983n, 1983o, 1983p, 1984j, 1984k, 1984l, 1984m, 1984n, 1984o, 1984p, 1984q, 1985i, 1985j, 1985k, 1985l, 1985m, 1985o,

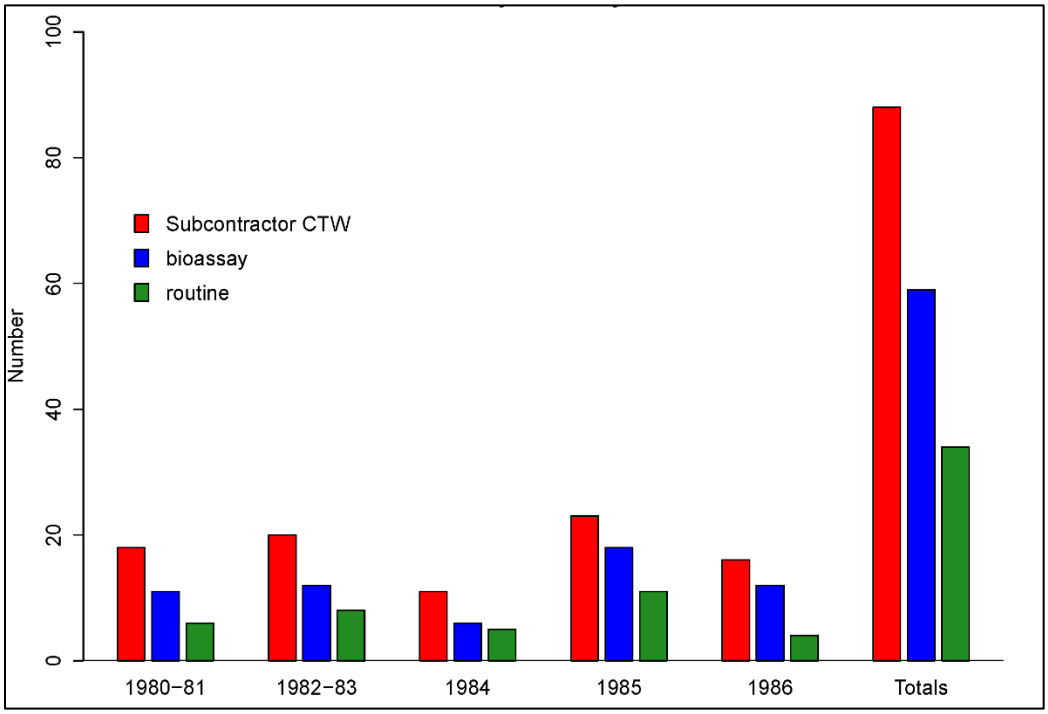


Figure 4-3. Bioassay totals by year.

1985p, 1985q, 1985r, 1986j, 1986k, 1986l, 1986m, 1986n, 1986o, 1986p). Attachment B, Table B-2, lists all known alpha and fission product airborne results for the Job Plans covering the 110 random subcontractor CTWs.

To fully evaluate the degree of monitoring of subcontractor CTWs, the Team reviewed sets of representative Radiation Survey Logsheets (RSLs) for Building 773-A. Logsheets of monitoring under Job Plans noted survey measurements, description of work and location, additional precautions or protections, and any observed contamination. For any observed personnel contamination, the results of decontamination efforts were also recorded. The RSL data were compared to Job Plan files covering the same dates, which resulted in the identification of several pairings of RSLs and the associated Job Plan. An example is presented for each year from 1981 through 1986. More complete sets of RSLs are known to be available at SRS.

1981

Figure 5-1 shows a portion of an RSL for work under a SWP Job Plan on April 21, 1981, along with a portion of the plan.

OSR 4-17 (Rev 4-72)

RADIATION SURVEY LOGSHEET – GENERAL

SURVEY OFFICE: E-037 | DATE OF SURVEY: 4-21-81

JOB LOCATION: C-002 | BLDG NO.: 773-A | LEVEL: Base. | DEPARTMENT: Const. | SWP, DPSOL, OR JOB PLAN NO.: JP-Plan

INSTRUMENT USED: ☐ JUNO ☒ ALPHA Eberline ☐ THYAC ☐ NEUTRON ☒ CUTIE PIE ☒ Swepex

AIR SAMPLED: ☐ STAPLEX ☐ IMPACTOR ☐ DUCT ☒ CAM ☐ KANNE

TIME SPENT ON JOB: 4 hr | TIME SURVEYED: 2-10 | PN

EXPOSURE RATE ESTABLISHED

A: 3 mR/hr + gen work area

B: mrad/mR/hr #

C: × 10⁻⁶ µCi ³H/cc #

D: × 10⁻⁶ µCi ³H/cc #

TRANSFERABLE CONTAMINATION DETECTED

AVERAGE 500 K d/m ∝ | MAXIMUM 5×10⁶ d/m ∝

DESCRIPTION OF SURVEY

☐ SEE SKETCH ☐ REVERSE SIDE ☐ ATTACHED

Surveyed for Const. to cut high level drain line several times in the above location. Fresh air plastic suits were worn to cut the line. A hand held band saw was used to cut the drain line. The line was cut in to four or five pieces and wrapped in plastic. The ends of the pipe had hubs on these hubs would cut holes in the plastic causing contam to get out.

OSR 14-8 (Rev. 9-61)

SPECIAL WORK PERMIT

TIME: 8:00 AM – 12:30 PM | BLDG.: 773-A | DATE: 4-28-81 – 4-29-81 | SWP NO.:

LOCATION: C-005, C-002, B-005, B-002 | DEPARTMENT: Construction

JOB DESCRIPTION: Project: 1959 | Install H/L Drain

W.O.: 4632-77

SPECIAL INSTRUCTIONS – MONITORING: ☐ AT START OF JOB ☒ INTERMITTENT ☐ CONTINUOUS

INSTRUCTIONS

WHEN MORE THAN ONE RATE IS LISTED ON SWP, STATE WHICH RATE WAS USED.

ENTER TIME IN RDI ON TIME SHEET.

HEALTH PHYSICS SHALL BE PRESENT FOR LINE BREAKS.

PERSONAL SURVEY IS REQUIRED WHEN LEAVING RADIATION DANGER ZONE.

☒ NO PERSONAL OUTER CLOTHING

☒ SPECIAL PROTECTION REQUIRED FOR CUTS OR ABRASIONS.

☐ TAPE GLOVES-CANVAS BOOTS TO COVER-ALLS.

☐ PROVIDE TIMEKEEPER.

Contact a HP ([redacted]) when moving to new location or when working in red or yellow painted area.

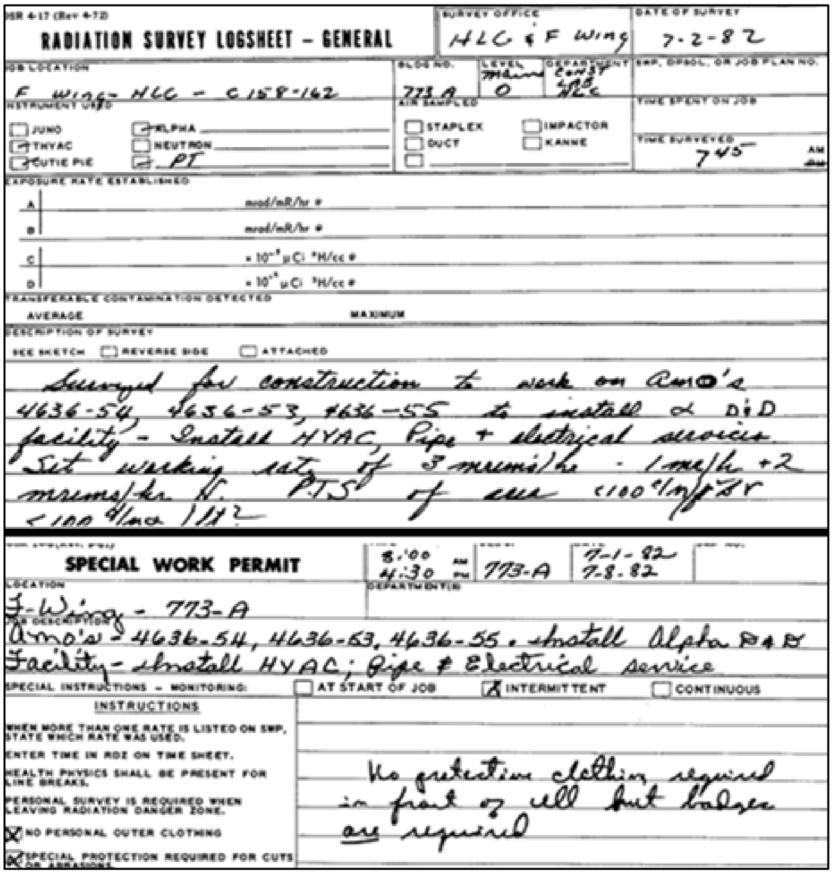
Full dress required for line breaks

Figure 5-1. Monitoring of high-level drain (HLD) work, 1981 (DuPont 1981p, 1981q).

Under this Job Plan, subcontractor CTWs cut a HLD line in C-002 as part of a project to replace the drain leading from hot cells and laboratories on the first floor. The work was monitored on an intermittent basis. There was a note for HP to be notified when work moved to a new area or when cutting involved certain painted areas. Transferable contamination averaged 5×10^5 dpm alpha. Airborne contamination was monitored by a continuous air sampler. Work was interrupted when the airborne activity was measured at the SRS administrative control limit. In another section of the form (not shown) it was indicated that external dose was tracked by pocket chamber dosimeters. Subcontractor CTWs wore respiratory protection and some of the subcontractor CTWs who were involved in this work were monitored by bioassay.

1982

Figure 5-2 shows a portion of an RSL for work on July 2, 1982, by subcontractor CTWs. The associated work order, spanning several months, was for the installation of the Alpha Decontamination and Decommissioning Facility.



RADIATION SURVEY LOGSHEET – GENERAL

SURVEY OFFICE: HLC & F Wing
DATE OF SURVEY: 7-2-82
JOB LOCATION: F Wing- HLC - C158-162
BLDG NO.: 773 A
LEVEL: Main 0
DEPARTMENT: Const SRS HLC
SWP, OPSOL, OR JOB PLAN NO.:
TIME SPENT ON JOB:
TIME SURVEYED: 745 AM
INSTRUMENT USED: JUNO; THYAC (checked); CUTIE PIE (checked); ALPHA (checked); NEUTRON; PT (checked)
AIR SAMPLED: STAPLEX; IMPACTOR; DUCT; KANNE
EXPOSURE RATE ESTABLISHED
A mrad/mR/hr @
B mrad/mR/hr @
C × 10⁻⁶ µCi ³H/cc @
D × 10⁻⁶ µCi ³H/cc @
TRANSFERABLE CONTAMINATION DETECTED
AVERAGE MAXIMUM
DESCRIPTION OF SURVEY
SEE SKETCH: REVERSE SIDE; ATTACHED

Surveyed for construction to work on AMO's 4636-54, 4636-53, 4636-55 to install α D&D facility - Install HVAC, Pipe + electrical services. Set working rate of 3 mrem/hr - 1 mr/h + 2 mrem/hr N. PTS of area <100 c/m βγ <100 d/m α /ft²

SPECIAL WORK PERMIT
8:00 AM 4:30 PM
773-A
7-1-82 7-8-82
LOCATION: F-Wing - 773-A
DEPARTMENT(S):
JOB DESCRIPTION: AMO's - 4636-54, 4636-53, 4636-55. Install Alpha D&D Facility - Install HVAC; Pipe & Electrical service
SPECIAL INSTRUCTIONS – MONITORING: AT START OF JOB; INTERMITTENT (checked); CONTINUOUS

INSTRUCTIONS
WHEN MORE THAN ONE RATE IS LISTED ON SWP, STATE WHICH RATE WAS USED.
ENTER TIME IN RDZ ON TIME SHEET.
HEALTH PHYSICS SHALL BE PRESENT FOR LINE BREAKS.
PERSONAL SURVEY IS REQUIRED WHEN LEAVING RADIATION DANGER ZONE.
NO PERSONAL OUTER CLOTHING (checked)
SPECIAL PROTECTION REQUIRED FOR CUTS OR ABRASIONS (checked)

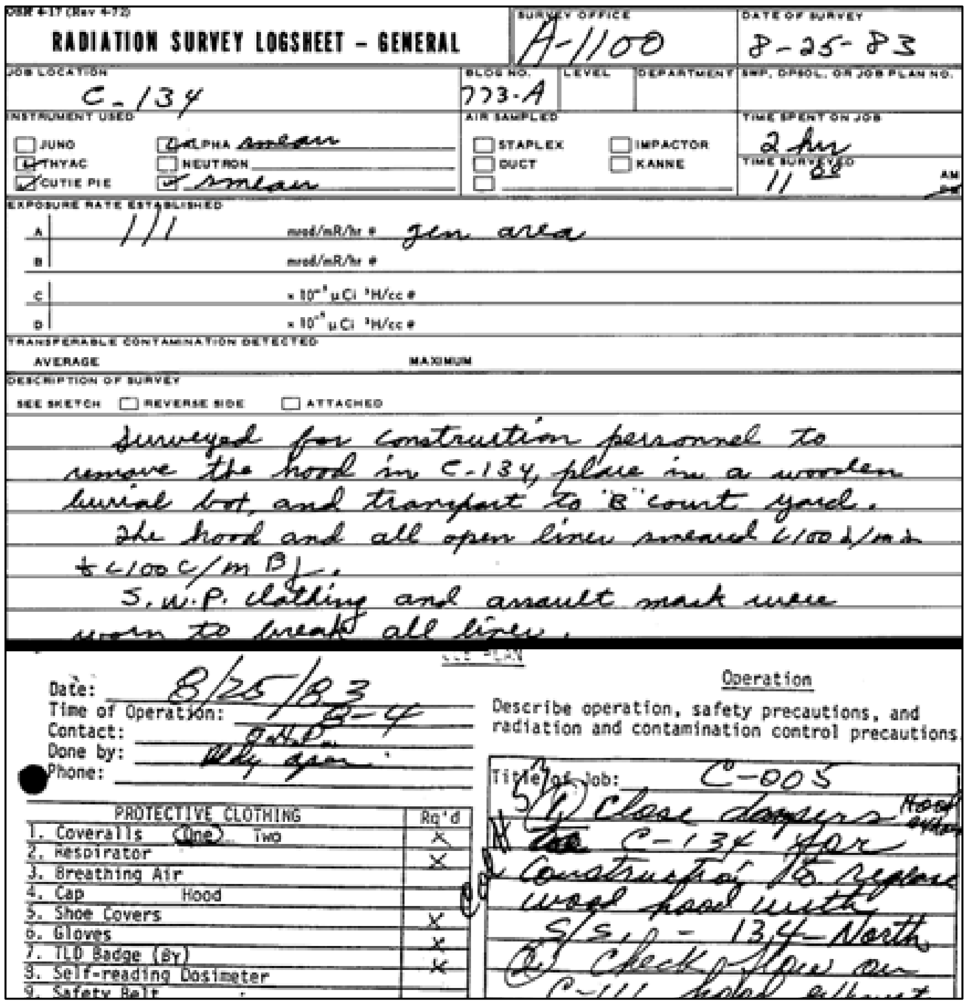
No protective clothing required in front of cell but badges are required

Figure 5-2. Monitoring of construction work, 1982 (DuPont 1982b, 1982k).

This work was also monitored on an intermittent basis. External dose was tracked by pocket chamber dosimeters. Both alpha and beta-gamma transferable contamination were measured at less-than-detection values. While this work had little potential for intake of radionuclides, some of the subcontractor CTWs who were involved in this work were monitored by bioassay.

1983

Figure 5-3 shows a portion of an RSL for work under a regular Job Plan on August 25, 1983, along with a portion of the Job Plan. Under the Job Plan, subcontractor CTWs removed a hood in C-134 and prepared the hood for burial. The work was monitored at the start and conclusion of work. Both alpha and beta-gamma transferable contamination were measured at less-than-detection values. Subcontractor CTWs used respiratory protection, and some of the subcontractor CTWs who were involved in this work were monitored by bioassay.


RADIATION SURVEY LOGSHEET – GENERAL

SURVEY OFFICE: A-1100 DATE OF SURVEY: 8-25-83

JOB LOCATION: C-134 BLDG NO.: 773-A LEVEL DEPARTMENT SWP, OPSOL, OR JOB PLAN NO.

INSTRUMENT USED: JUNO; THYAC; CUTIE PIE; ALPHA smear; NEUTRON; smear

AIR SAMPLED: STAPLEX; DUCT; IMPACTOR; KANNE

TIME SPENT ON JOB: 2 hr TIME SURVEYED: 11 AM PM

EXPOSURE RATE ESTABLISHED

A /// mrad/mR/hr # gen area

B mrad/mR/hr #

C × 10⁻⁵ µCi ³H/cc #

D × 10⁻⁵ µCi ³H/cc #

TRANSFERABLE CONTAMINATION DETECTED

AVERAGE MAXIMUM

DESCRIPTION OF SURVEY

SEE SKETCH REVERSE SIDE ATTACHED

Surveyed for construction personnel to remove the hood in C-134, place in a wooden burial box, and transport to 'B' court yard.

The hood and all open lines smeared <100 d/m α & <100 c/m β/γ.

S.W.P. clothing and assault mask were worn to break all lines.

Date: 8/25/83

Time of Operation: 8-4

Contact:

Done by:

Phone:

Operation

Describe operation, safety precautions, and radiation and contamination control precautions.

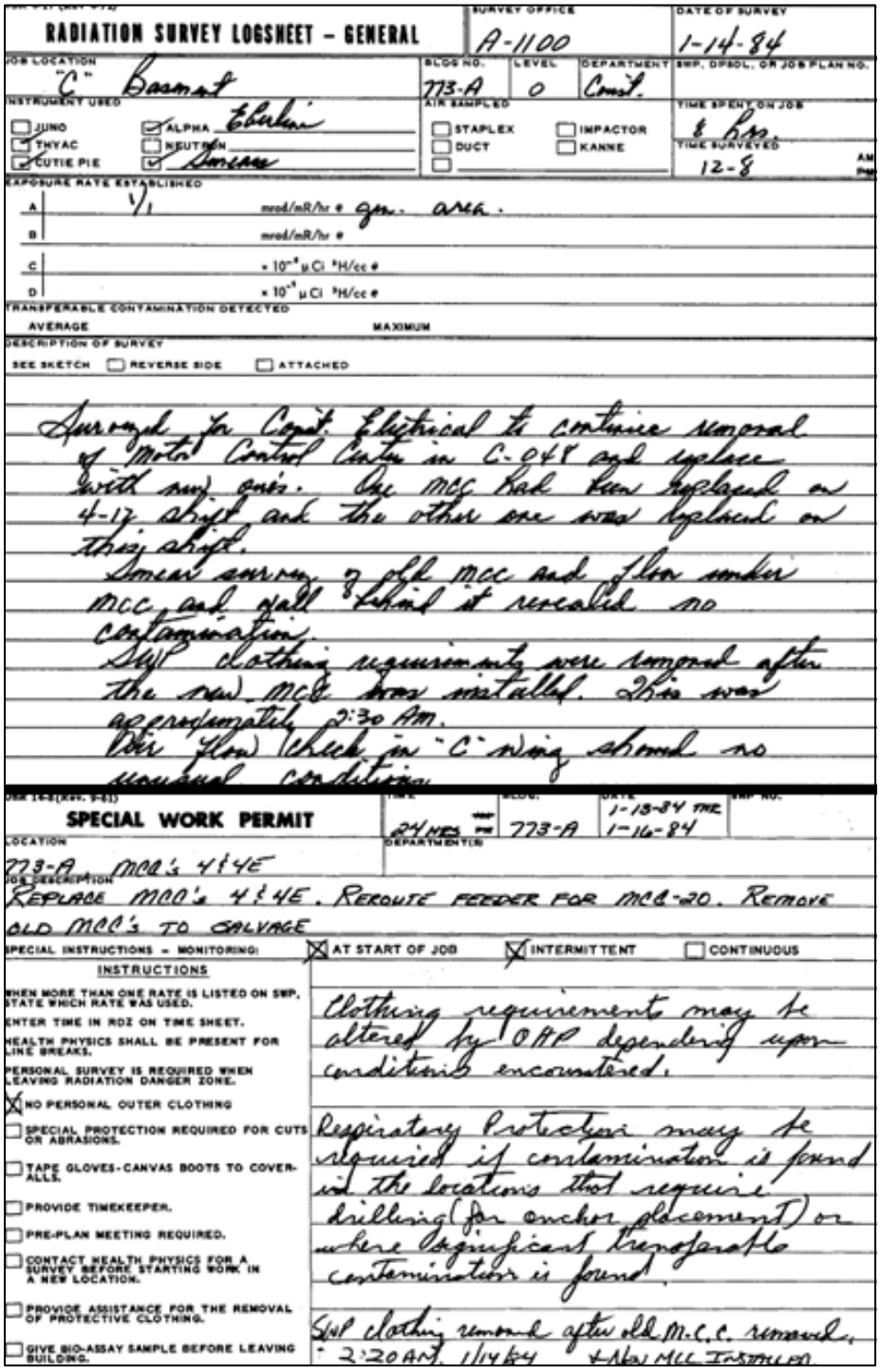
Title of Job: C-005

PROTECTIVE CLOTHING	Rq'd
1. Coveralls (One) Two	X
2. Respirator	X
3. Breathing Air	
4. Cap Hood	
5. Shoe Covers	X
6. Gloves	X
7. TLD Badge (By)	X
8. Self-reading Dosimeter	
9. Safety Belt	

Figure 5-3. Monitoring of hood removal, 1983 (DuPont 1983q, 1983b).

1984

Figure 5-4 shows a portion of an RSL for monitoring of work on January 14, 1984, by subcontractor CTWs to replace a motor control center (MCC) in C-048. The work was monitored intermittently and at the conclusion. While the work permit listed a requirement for respiratory protection if contamination was found, HP observed no unusual conditions and did not detect any surface or airborne contamination. Continuous air monitoring results available for the work area show no results greater than detection levels (DuPont 1983r).



RADIATION SURVEY LOGSHEET – GENERAL

SURVEY OFFICE: A-1100 | DATE OF SURVEY: 1-14-84

JOB LOCATION: "C" Basmt | BLDG NO.: 773-A | LEVEL: 0 | DEPARTMENT: Const. | SWP, DPSOL, OR JOB PLAN NO.:

INSTRUMENT USED: ☐ JUNO ☑ ALPHA Eberline ☐ THYAC ☐ NEUTRON ☑ CUTIE PIE ☑ Ludlum

AIR SAMPLED: ☐ STAPLEX ☐ IMPACTOR ☐ DUCT ☐ KANNE

TIME SPENT ON JOB: 8 hrs.

TIME SURVEYED: 12-8 AM

EXPOSURE RATE ESTABLISHED

A: 1/1 mrad/mR/hr @ gen. area.

B: mrad/mR/hr @

C: × 10^{-6} μCi ^{3}H/cc @

D: × 10^{-6} μCi ^{3}H/cc @

TRANSFERABLE CONTAMINATION DETECTED

AVERAGE MAXIMUM

DESCRIPTION OF SURVEY

SEE SKETCH ☐ REVERSE SIDE ☐ ATTACHED

Surveyed for Const. Electrical to continue removal of Motor Control Center in C-048 and replace with new one. One MCC Rack was replaced on 4-17 shift and the other one was replaced on this shift.

Smear survey of old MCC and floor under MCC and wall behind it revealed no contamination.

PPE clothing requirements were removed after the new MCC was installed. This was approximately 2:30 AM.

Per Flow Check in "C" wing showed no unusual conditions.

SPECIAL WORK PERMIT

TIME: 24 HRS AM PM | BLDG: 773-A | DATE: 1-13-84 THR 1-16-84 | SWP NO.:

LOCATION: 773-A MCC's 4 & 4E

DEPARTMENT(S):

JOB DESCRIPTION: REPLACE MCC's 4 & 4E. REROUTE FEEDER FOR MCC-20. REMOVE OLD MCC's TO SALVAGE

SPECIAL INSTRUCTIONS – MONITORING: ☒ AT START OF JOB ☒ INTERMITTENT ☐ CONTINUOUS

INSTRUCTIONS

WHEN MORE THAN ONE RATE IS LISTED ON SWP, STATE WHICH RATE WAS USED.

ENTER TIME IN RDZ ON TIME SHEET.

HEALTH PHYSICS SHALL BE PRESENT FOR LINE BREAKS.

PERSONAL SURVEY IS REQUIRED WHEN LEAVING RADIATION DANGER ZONE.

☒ NO PERSONAL OUTER CLOTHING

☐ SPECIAL PROTECTION REQUIRED FOR CUTS OR ABRASIONS.

☐ TAPE GLOVES-CANVAS BOOTS TO COVER-ALLS.

☐ PROVIDE TIMEKEEPER.

☐ PRE-PLAN MEETING REQUIRED.

☐ CONTACT HEALTH PHYSICS FOR A SURVEY BEFORE STARTING WORK IN A NEW LOCATION.

☐ PROVIDE ASSISTANCE FOR THE REMOVAL OF PROTECTIVE CLOTHING.

☐ GIVE BIO-ASSAY SAMPLE BEFORE LEAVING BUILDING.

Clothing requirements may be altered by OAP depending upon conditions encountered.

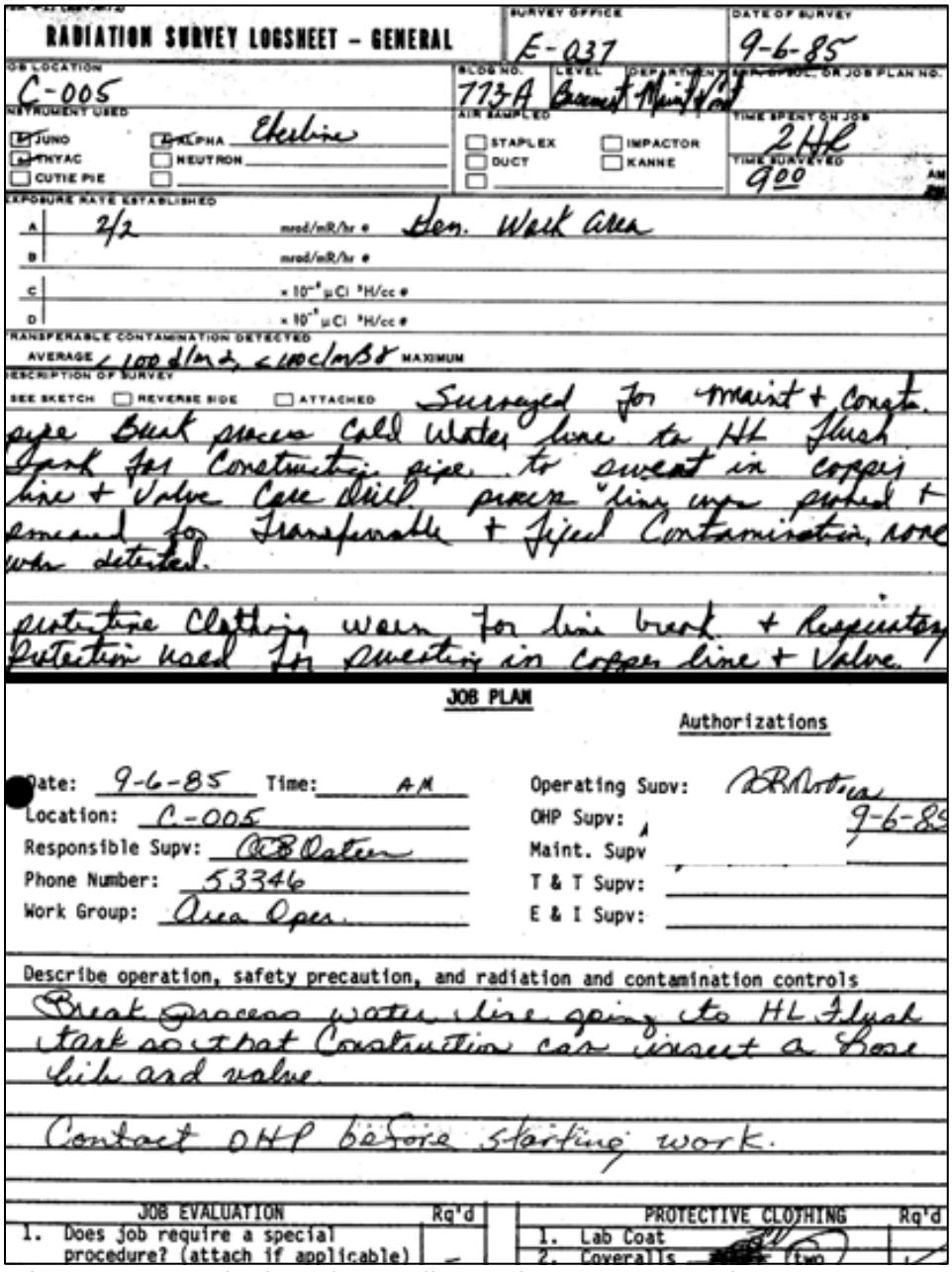
Respiratory Protection may be required if contamination is found in the locations that require drilling (for anchor placement) or where significant transferable contamination is found.

PPE clothing removed after old M.C.C. removed. ~ 2:20 AM. 1/14/84 + New MCC Installed

Figure 5-4. Monitoring of MCC replacement, 1984 (DuPont 1984a, 1984r).

1985

Figure 5-5 shows a portion of an RSL for monitoring of work on September 6, 1985, by both DuPont and subcontractor CTWs to replace a water line, valve, and bib in C-005. The work was monitored at the start, intermittently, and at the conclusion of work. Both alpha and beta-gamma transferable contamination were measured at less-than-detection values. DuPont and subcontractor CTWs used respiratory protection. Some of the subcontractor CTWs who were involved in this work were monitored by bioassay.



RADIATION SURVEY LOGSHEET – GENERAL

SURVEY OFFICE: E-037

DATE OF SURVEY: 9-6-85

JOB LOCATION: C-005

BLDG NO.: 773-A

LEVEL:

DEPARTMENT: Barrier Maint/Const

RWP PROT. OR JOB PLAN NO.:

INSTRUMENT USED: ☒ JUNO ☐ THYAC ☐ CUTIE PIE ☐ ALPHA Electra ☐ NEUTRON

AIR SAMPLED: ☐ STAPLEX ☐ DUCT ☐ IMPACTOR ☐ KANNE

TIME SPENT ON JOB: 2 Hr

TIME SURVEYED: 900 AM

EXPOSURE RATE ESTABLISHED

A 2/2 mrad/mR/hr @ Gen. Work Area

B mrad/mR/hr @

C × 10^{-6} µCi ^{3}H/cc @

D × 10^{-5} µCi ^{3}H/cc @

TRANSFERABLE CONTAMINATION DETECTED

AVERAGE < 100 d/m/100 cm²/hr < 100 c/m/100 cm² MAXIMUM

DESCRIPTION OF SURVEY

SEE SKETCH ☐ REVERSE SIDE ☐ ATTACHED

Surveyed for maint + Constr. pipe Break process Cold Water line to HL flush tank for Construction pipe to sweat in copper line + Valve Core Drill process "line was probed + smeared for Transferable + fixed Contamination, none was detected.

protective Clothing worn for line break + Respiratory Protection used for sweating in copper line + Valve.

JOB PLAN

Authorizations

Date: 9-6-85 Time: AM

Location: C-005

Responsible Supv: [illegible] Oates

Phone Number: 53346

Work Group: Area Oper.

Operating Supv: [illegible]

OHP Supv: [illegible] 9-6-85

Maint. Supv

T & T Supv:

E & I Supv:

Describe operation, safety precaution, and radiation and contamination controls

Break process water line going to HL flush tank so that Construction can insert a hose bib and valve

Contact OHP before starting work.

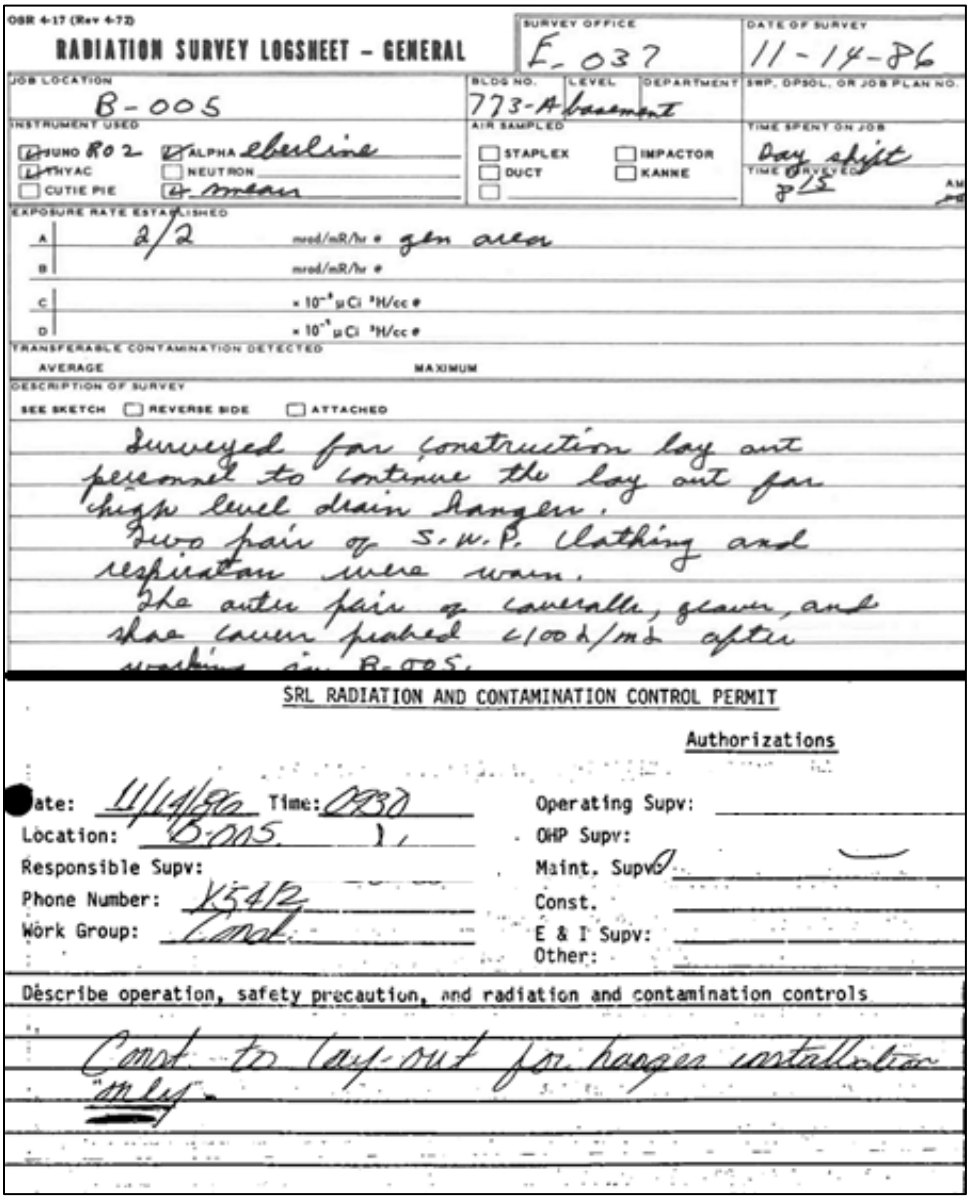
JOB EVALUATION	Rq'd
1. Does job require a special procedure? (attach if applicable)	–

PROTECTIVE CLOTHING	Rq'd
1. Lab Coat	
2. Coveralls [illegible] (two	✓

Figure 5-5. Monitoring of water line replacement, 1985 (DuPont 1985c, 1985n).

1986

Figure 5-6 shows a portion of an RSL for work under a Job Plan on November 14, 1986, along with a portion of the Job Plan.



OBR 4-17 (Rev 4-72)

RADIATION SURVEY LOGSHEET – GENERAL

SURVEY OFFICE: E-037 | DATE OF SURVEY: 11-14-86

JOB LOCATION: B-005 | BLDG NO.: 773-A | LEVEL: basement | DEPARTMENT | SWP, OPSOL, OR JOB PLAN NO.

INSTRUMENT USED: ☑ RUNO RO 2 ☑ ALPHA eberline ☐ THYAC ☐ NEUTRON ☐ CUTIE PIE ☑ mean

AIR SAMPLED: ☐ STAPLEX ☐ IMPACTOR ☐ DUCT ☐ KANNE

TIME SPENT ON JOB: Day shift | TIME SURVEYED: 9:15 AM

EXPOSURE RATE ESTABLISHED

A: 2/2 mrad/mR/hr # gen area

B: mrad/mR/hr #

C: × 10^{-9} μCi ^{3}H/cc #

D: × 10^{-9} μCi ^{3}H/cc #

TRANSFERABLE CONTAMINATION DETECTED

AVERAGE MAXIMUM

DESCRIPTION OF SURVEY

SEE SKETCH ☐ REVERSE SIDE ☐ ATTACHED

Surveyed for construction lay out personnel to continue the lay out for high level drain hangers.
Two pair of S.W.P. clothing and respirators were worn.
The outer pair of coveralls, gloves, and shoe covers probed <100 d/m after working in B-005.

SRL RADIATION AND CONTAMINATION CONTROL PERMIT

Authorizations

Date: 11/14/86 Time: 0830

Location: B-005

Responsible Supv:

Phone Number: X5412

Work Group: Const.

Operating Supv:

OHP Supv:

Maint. Supv:

Const.

E & I Supv:

Other:

Describe operation, safety precaution, and radiation and contamination controls

Const. to lay-out for hanger installation only.

Figure 5-6. Monitoring of work to layout HLD hangers, 1986 (DuPont 1986c, 1986d).

Under this Job Plan, subcontractor CTWs marked the layout for HLD hangers in B-005. The work was monitored at the start, intermittently, and at the conclusion of work. Alpha transferable contamination were measured at less-than-detection values. Subcontractor CTWs wore respiratory protection. Some (cohort) of the subcontractor CTWs who were involved in this work were monitored by bioassay.

6.0 EVALUATION OF INCIDENT MONITORING

Area contamination and worker contamination were actively monitored during the performance of subcontractor jobs. While ORAU has only partial records, some subcontractor CTW contamination incidents were found during review of the RSL and worker bioassay history records. The types of work performed and potential for radiation exposures were similar for both DuPont and subcontractor CTWs. While Job Plans and SWPs indicated the expected conditions, monitoring during the tasks might have determined whether workers were exposed and if bioassays were necessary. When air sampling and contamination monitoring showed no activity, bioassays might have not been requested even in those cases where the plans or permits indicated an uptake was possible. Examples of incidents involving subcontractor CTW associated with Job Plan files and RSL reviewed in this report with follow-up actions include:

- In February 1980 a subcontractor CTW working on a multiple-week project to dismantle equipment in B-147 was found to be working with high airborne alpha radioactivity without a respirator by HP, which was monitoring the work intermittently (DuPont 1981a, p. 24). Results of fecal, urine, and in vivo bioassay indicated the worker received an intake of less than 10% of the maximum permissible body burden (ORAUT 2017; DuPont 1974–1984, pp. 290–295).

- In July 1983, 13 subcontractor CTWs were contaminated while working in C-005 under a Job Plan for the basement of Building 773-A (DuPont 1983b, pp. 80-81). A redacted copy of the Job Plan is provided in Figure 6-1. HP monitored the work intermittently. HP requested bioassay samples to be collected from each worker. The reported results ranged from <0.1 to 0.5 dpm/L plutonium and from <0.3 to 0.5 dpm/L americium (DuPont 1987d, pp. 36–57). Figures 6-2 and 6-3 show redacted copies of two of the special bioassay request cards completed by HP in response to the contamination and updated with results of analysis by the laboratory. These cards demonstrate the range of the reported bioassay results for americium.

  The hands of one of the subcontractor CTWs working on the painting task were contaminated while removing contaminated coveralls. The CTW apparently touched his face resulting in nasal contamination. HP surveyed the worker, performed nasal monitoring followed by urine bioassay; 0.1 dpm/L Pu was reported for the worker (DuPont 1987d, p 54). Figure 6-4 shows a description of contamination with follow-up monitoring.

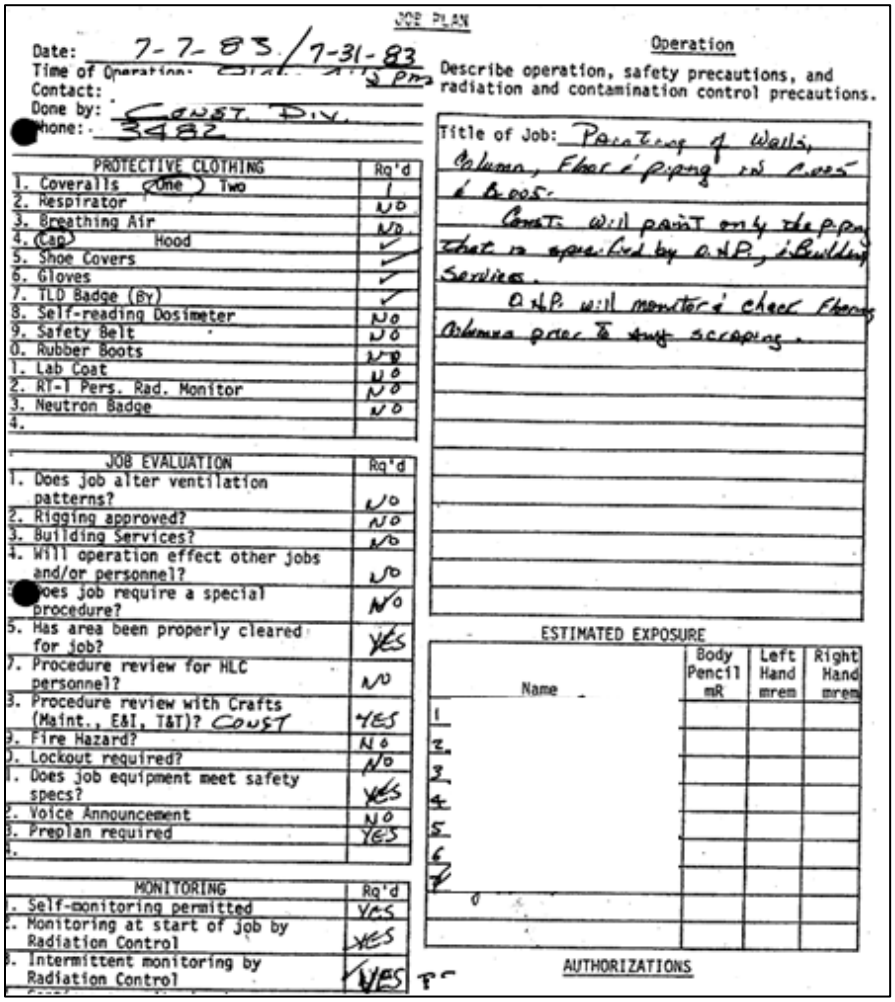
- On November 11 and 12, 1983, 12 subcontractor CTWs replacing an MCC in B-048 received potential intakes of plutonium (DuPont 1983c, pp. 193-196). Urine bioassay samples were collected from all 12 workers. The result for one worker was reported as 0.2 dpm/1.5 L of plutonium, while results for the rest were reported as <0.1 dpm/1.5 L. All workers were reported to have <0.3 dpm/1.5 L americium (ORAUT 2017; DuPont 1986i, p. 106; 1987d, pp. 60–68).

- On November 4, 1986, alpha airborne contamination above the normal level was observed in B-005 by HP as a subcontractor CTW was decontaminating the room (DuPont 1986c, pp. 11–17). The worker picked up a bag with removable contamination of 1×10^6 dpm without wearing a respirator. HP requested special urine and fecal bioassay samples. Results of those analysis revealed intakes of 6,880 dpm insoluble ^{239}Pu, 1,200 dpm soluble ^{239}Pu, 3,550 dpm insoluble ^{241}Am, and 644 dpm soluble ^{241}Am. The worker was subsequently added to the Transuranic Registry (ORAUT 2017; DuPont 1986d).

- On December 5, 1986 the gloves of two subcontractor CTWs were contaminated to 6,000 dpm alpha while working in B-005 installing a new high-level drain assembly. Outer overalls of two other subcontractor CTW working on the portion of the drain assembly in C-005 were

contaminated to 20,000 dpm alpha. The inner coveralls of both coveralls were surveyed at <100 dpm alpha. Figure 6-5 shows portions of the RSL and Job Plan.

- These examples demonstrate that HP monitored work performed by subcontractor CTWs well. Some tasks were monitored continuously and others intermittently. The examples show that HP used workplace and worker observation, radiation surveys, and constant air monitoring to monitor work conditions as well as follow-up surveys and bioassay to assess worker contamination and possible assimilation of radionuclides. Additional examples on incidents involving subcontractor CTW are available.



JOB PLAN

Date: 7-7-83 / 7-31-83
Time of Operation: Start ... 2 pm
Contact:
Done by: CONST. DIV.
Phone: 3482

Operation
Describe operation, safety precautions, and radiation and contamination control precautions.

Title of Job: Painting of Walls, Columns, Floor & piping in Cross & Boos.
Const will paint only the pipe that is specified by O&P, Building Services.
O&P will monitor & check Floors Columns prior to any scraping.

PROTECTIVE CLOTHING	Rq'd
1. Coveralls (One) Two	1
2. Respirator	NO
3. Breathing Air	NO
4. (Cap) Hood	✓
5. Shoe Covers	✓
6. Gloves	✓
7. TLD Badge (BY)	✓
8. Self-reading Dosimeter	NO
9. Safety Belt	NO
0. Rubber Boots	NO
1. Lab Coat	NO
2. RT-1 Pers. Rad. Monitor	NO
3. Neutron Badge	NO
4.	

JOB EVALUATION	Rq'd
1. Does job alter ventilation patterns?	NO
2. Rigging approved?	NO
3. Building Services?	NO
4. Will operation effect other jobs and/or personnel?	NO
Does job require a special procedure?	NO
5. Has area been properly cleared for job?	YES
7. Procedure review for HLC personnel?	NO
8. Procedure review with Crafts (Maint., E&I, T&T)? CONST	YES
9. Fire Hazard?	NO
0. Lockout required?	NO
1. Does job equipment meet safety specs?	YES
2. Voice Announcement	NO
3. Preplan required	YES
4.	

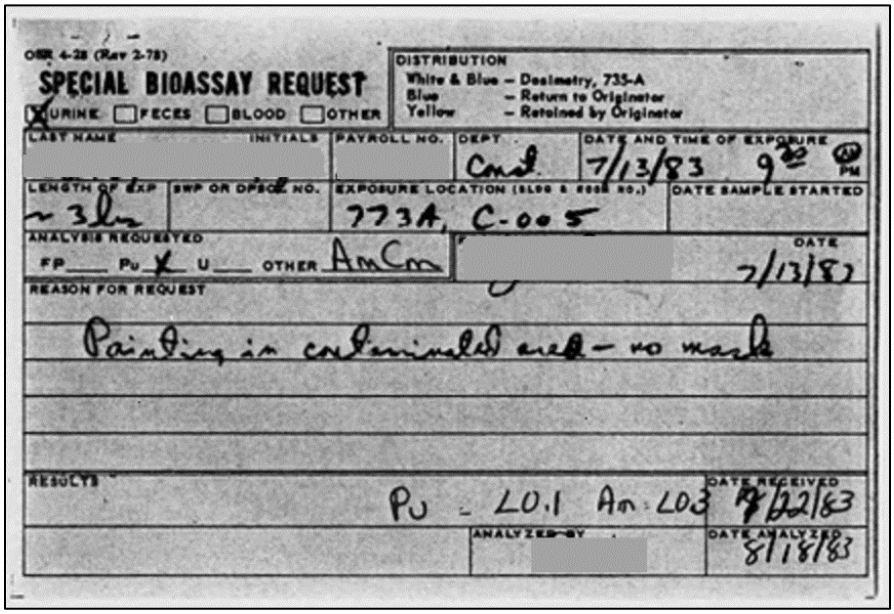
MONITORING	Rq'd
1. Self-monitoring permitted	YES
2. Monitoring at start of job by Radiation Control	YES
3. Intermittent monitoring by Radiation Control	YES

ESTIMATED EXPOSURE

Name	Body Pencil mR	Left Hand mrem	Right Hand mrem
1			
2			
3			
4			
5			
6			
7			
0			

AUTHORIZATIONS

Figure 6-1. Job plan issued for painting in B-005 and C-005, July 1983 (DuPont 1983b, p. 80).



OSR 4-28 (Rev 2-78)

SPECIAL BIOASSAY REQUEST

DISTRIBUTION
White & Blue – Dosimetry, 735-A
Blue – Return to Originator
Yellow – Retained by Originator

X URINE ☐ FECES ☐ BLOOD ☐ OTHER

LAST NAME / INITIALS	PAYROLL NO.	DEPT	DATE AND TIME OF EXPOSURE
		Const	7/13/83 9 AM PM

LENGTH OF EXP	SWP OR DPSOL NO.	EXPOSURE LOCATION (BLDG & ROOM NO.)	DATE SAMPLE STARTED
~3 hr		773A, C-005	

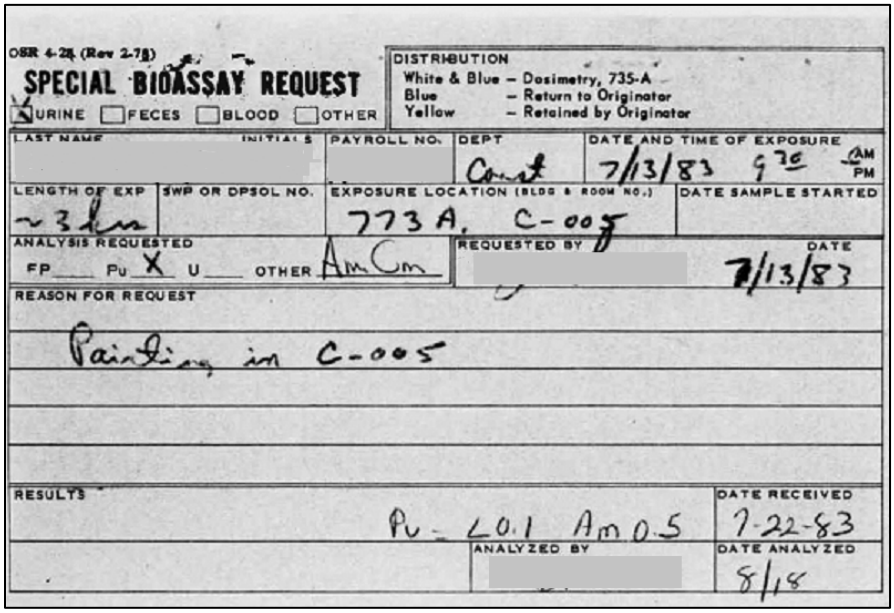
ANALYSIS REQUESTED: FP ___ Pu X U ___ OTHER Am Cm — DATE 7/13/83

REASON FOR REQUEST: Painting in contaminated area – no mask

RESULTS: Pu – L0.1 Am L03 — DATE RECEIVED 7/22/83

ANALYZED BY [redacted] — DATE ANALYZED 8/18/83

Figure 6-2. Redacted special bioassay request card (DuPont 1987d, p. 35).



OSR 4-28 (Rev 2-78)

SPECIAL BIOASSAY REQUEST

DISTRIBUTION
White & Blue – Dosimetry, 735-A
Blue – Return to Originator
Yellow – Retained by Originator

X URINE ☐ FECES ☐ BLOOD ☐ OTHER

LAST NAME / INITIALS	PAYROLL NO.	DEPT	DATE AND TIME OF EXPOSURE
[redacted]		Const	7/13/83 9 AM PM

LENGTH OF EXP	SWP OR DPSOL NO.	EXPOSURE LOCATION (BLDG & ROOM NO.)	DATE SAMPLE STARTED
~3 hr		773A, C-005	

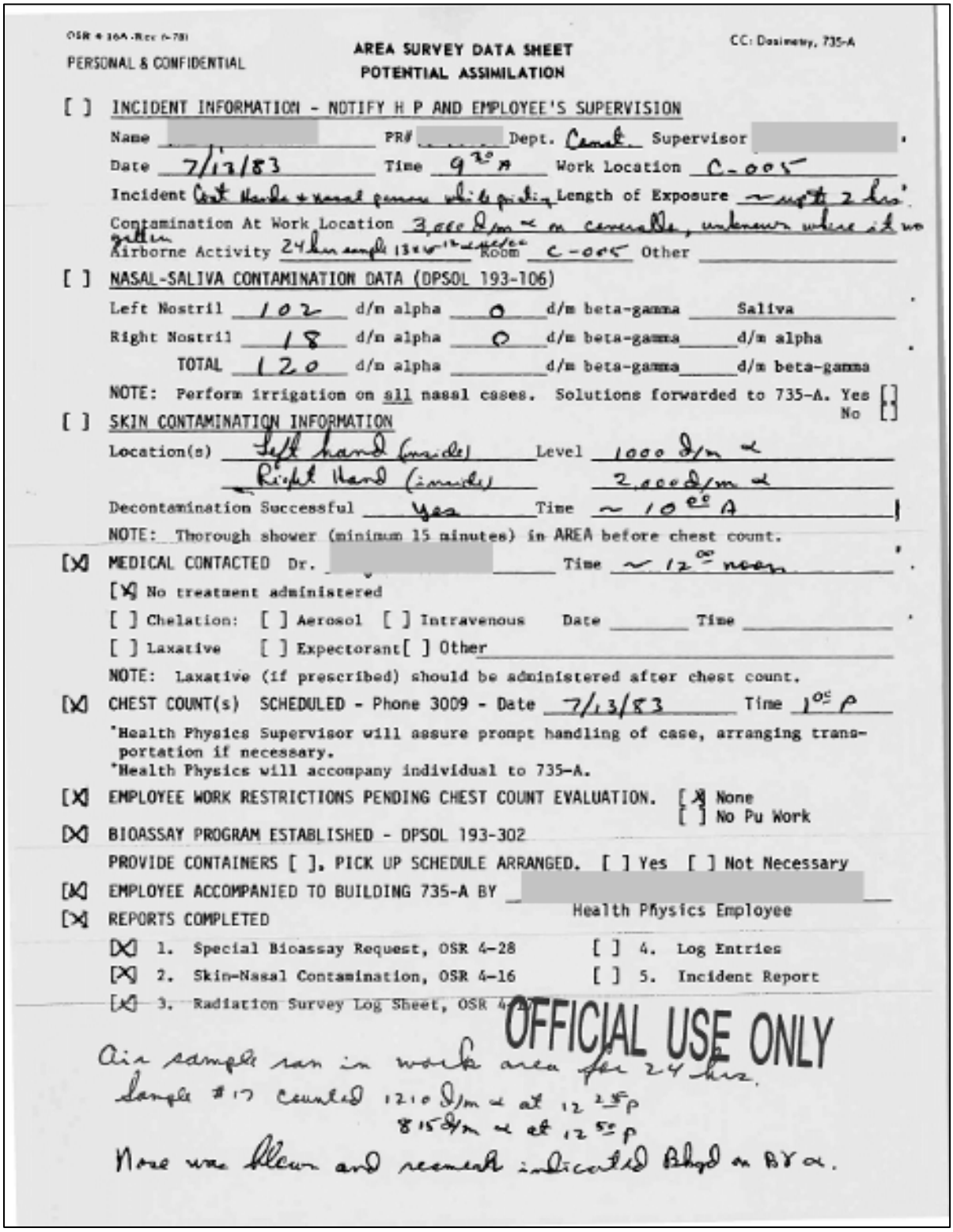
ANALYSIS REQUESTED: FP ___ Pu X U ___ OTHER Am Cm — REQUESTED BY [redacted] — DATE 7/13/83

REASON FOR REQUEST: Painting in C-005

RESULTS: Pu – L0.1 Am 0.5 — DATE RECEIVED 7-22-83

ANALYZED BY [redacted] — DATE ANALYZED 8/18

Figure 6-3. Redacted special bioassay request card with positive ^{241}Am result (DuPont 1987d, p. 57).



OSR # 16A (Rev 6-78)

PERSONAL & CONFIDENTIAL

AREA SURVEY DATA SHEET
POTENTIAL ASSIMILATION

CC: Dosimetry, 735-A

[ ] INCIDENT INFORMATION - NOTIFY H P AND EMPLOYEE'S SUPERVISION

Name [redacted] PR# _____ Dept. Const. Supervisor [redacted]

Date 7/13/83 Time 9:20 A Work Location C-005

Incident Cut Hands + wrist person while grinding Length of Exposure ~ upto 2 hrs

Contamination At Work Location 3,000 d/m α on concrete, unknown where it was gotten

Airborne Activity 24 hr sample 13×10⁻¹² μc/cc Room C-005 Other _____

[ ] NASAL-SALIVA CONTAMINATION DATA (DPSOL 193-106)

Left Nostril 102 d/m alpha 0 d/m beta-gamma Saliva

Right Nostril 18 d/m alpha 0 d/m beta-gamma _____ d/m alpha

TOTAL 120 d/m alpha _____ d/m beta-gamma _____ d/m beta-gamma

NOTE: Perform irrigation on all nasal cases. Solutions forwarded to 735-A. Yes [ ] No [ ]

[ ] SKIN CONTAMINATION INFORMATION

Location(s) Left hand (inside) Level 1000 d/m α

Right Hand (inside) 2,000 d/m α

Decontamination Successful Yes Time ~ 10:00 A

NOTE: Thorough shower (minimum 15 minutes) in AREA before chest count.

[X] MEDICAL CONTACTED Dr. [redacted] Time ~ 12:00 noon

[X] No treatment administered

[ ] Chelation: [ ] Aerosol [ ] Intravenous Date _____ Time _____

[ ] Laxative [ ] Expectorant [ ] Other _____

NOTE: Laxative (if prescribed) should be administered after chest count.

[X] CHEST COUNT(s) SCHEDULED - Phone 3009 - Date 7/13/83 Time 1:00 P

*Health Physics Supervisor will assure prompt handling of case, arranging transportation if necessary.
*Health Physics will accompany individual to 735-A.

[X] EMPLOYEE WORK RESTRICTIONS PENDING CHEST COUNT EVALUATION. [X] None [ ] No Pu Work

[X] BIOASSAY PROGRAM ESTABLISHED - DPSOL 193-302

PROVIDE CONTAINERS [ ], PICK UP SCHEDULE ARRANGED. [ ] Yes [ ] Not Necessary

[X] EMPLOYEE ACCOMPANIED TO BUILDING 735-A BY [redacted] Health Physics Employee

[X] REPORTS COMPLETED

[X] 1. Special Bioassay Request, OSR 4-28 [ ] 4. Log Entries

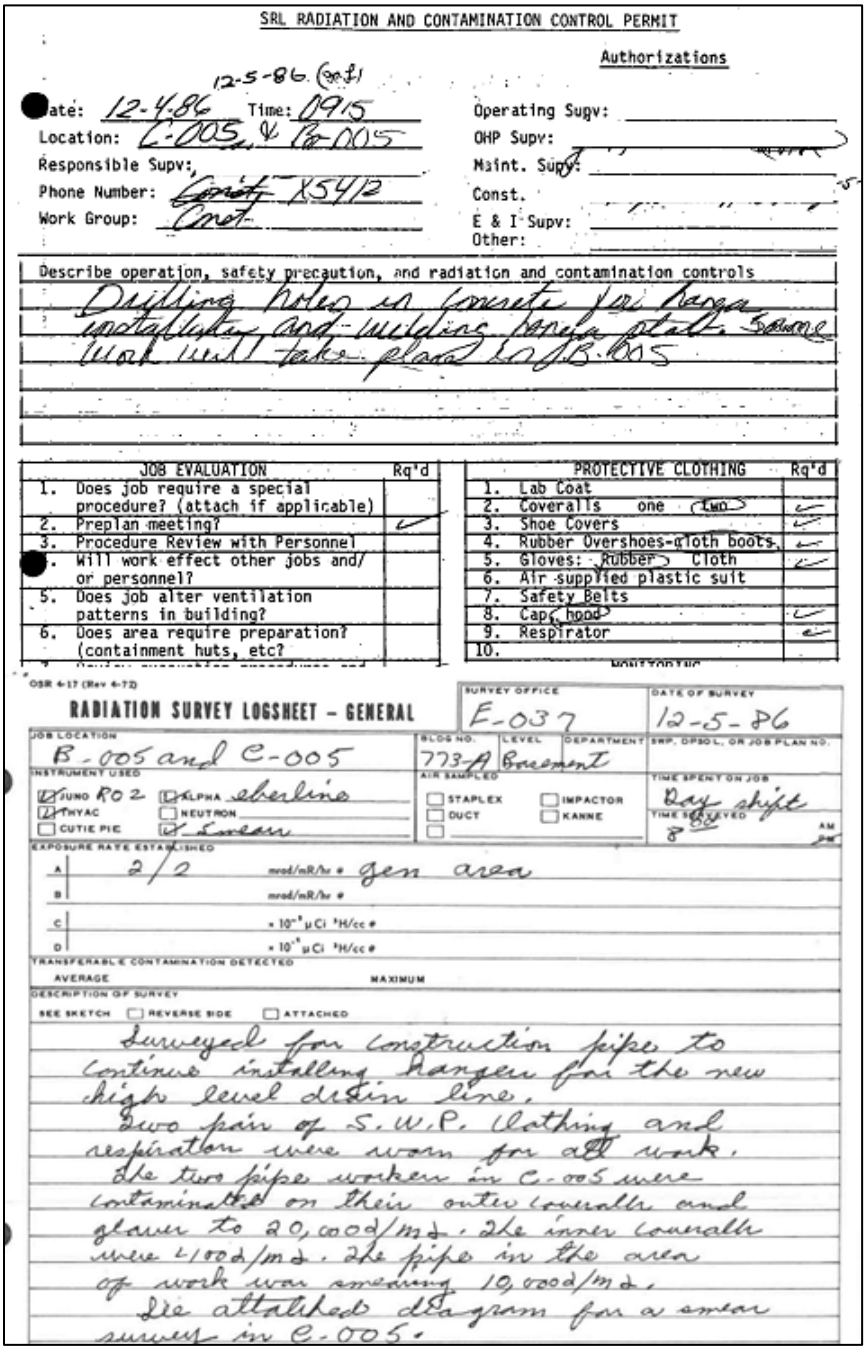
[X] 2. Skin-Nasal Contamination, OSR 4-16 [ ] 5. Incident Report

[X] 3. Radiation Survey Log Sheet, OSR 4-[illegible]

OFFICIAL USE ONLY

Air sample ran in work area for 24 hrs.
Sample #17 counted 1210 d/m α at 12:25 p
815 d/m α at 12:50 p
Nose was blown and results indicated Bkgd on BY α.

Figure 6-4. Area survey data sheet showing details on worker contamination (DuPont 1987d, p. 56).



SRL RADIATION AND CONTAMINATION CONTROL PERMIT

Authorizations

12-5-86 (on file)

Date: 12-4-86 Time: 0915

Location: C-005 & B-005

Responsible Supv:

Phone Number: Cont X5412

Work Group: Cont

Operating Supv:

OHP Supv:

Maint. Supv:

Const.

E & I Supv:

Other:

Describe operation, safety precaution, and radiation and contamination controls

Drilling holes in concrete for piping installation and welding piping plate hanger work will take place in B-005

JOB EVALUATION	Rq'd
1. Does job require a special procedure? (attach if applicable)	
2. Preplan meeting?	✓
3. Procedure Review with Personnel	
4. Will work effect other jobs and/or personnel?	
5. Does job alter ventilation patterns in building?	
6. Does area require preparation? (containment huts, etc?	

PROTECTIVE CLOTHING	Rq'd
1. Lab Coat	
2. Coveralls one (two)	✓
3. Shoe Covers	✓
4. Rubber Overshoes-cloth boots	✓
5. Gloves: Rubber Cloth	✓
6. Air-supplied plastic suit	
7. Safety Belts	
8. Caps, hood	✓
9. Respirator	✓
10.	

OSR 4-17 (Rev 4-72)

RADIATION SURVEY LOGSHEET - GENERAL

SURVEY OFFICE: E-037

DATE OF SURVEY: 12-5-86

JOB LOCATION: B-005 and C-005

BLDG NO.: 773-A LEVEL: Basement DEPARTMENT:

SWP, OPSOL, OR JOB PLAN NO.:

INSTRUMENT USED: ☑ JUNO RO 2 ☑ ALPHA eberline ☑ THYAC ☐ NEUTRON ☐ CUTIE PIE ☑ Smear

AIR SAMPLED: ☐ STAPLEX ☐ IMPACTOR ☐ DUCT ☐ KANNE

TIME SPENT ON JOB: Day shift

TIME SURVEYED: 8 AM PM

EXPOSURE RATE ESTABLISHED

A: 2/2 mrad/hr @ gen area

B: mrad/hr @

C: × 10^{-6} µCi ^{3}H/cc @

D: × 10^{-5} µCi ^{3}H/cc @

TRANSFERABLE CONTAMINATION DETECTED

AVERAGE MAXIMUM

DESCRIPTION OF SURVEY

SEE SKETCH ☐ REVERSE SIDE ☐ ATTACHED

Surveyed for construction pipe to continue installing hangers for the new high level drain line.

Two pair of S.W.P. clothing and respirators were worn for all work.

The two pipe workers in C-005 were contaminated on their outer coveralls and gloves to 20,000 d/m 2. The inner coveralls were 4,000 d/m 2. The pipe in the area of work was smearing 10,000 d/m 2.

See attached diagram for a smear survey in C-005.

Figure 6-5. Portions of Job Plan and radiation survey logsheet for work in B-005/C-005, December 5, 1986 (DuPont 1986b, p. 351; DuPont 1986 c, p. 37).

7.0 CONCLUSIONS

The ORAU Team has determined that subcontractor CTWs were monitored along with DuPont CTWs for exposures to occupational radiation exposures during the years 1980 through 1986.

As discussed in Section 3.1 and shown in Table 3-1, 99% of DuPont CTWs and 97% of subcontractor CTWs in this evaluation from 1980 through 1986 were monitored for external dose. 100% of subcontractor CTWs were monitored for external dose from 1980 to 1982, 1984, and 1986. SRS monitored both DuPont and subcontractor CTWs for external dose similarly.

In relation to monitoring for internal intake of radionuclides, bioassay data shows 67.0% of randomly selected subcontractor CTW wearing respiratory protection were monitored for intakes of radionuclides from 1980 through 1986. Almost 38% of those workers were on routine monitoring for one or more radionuclides in accordance with DuPont (1971). In cases for which bioassay data was not found for a worker or job, the Team found bioassay results for a coworker on the same job for another 26% of the randomly selected set of workers wearing respiratory protection. By procedure, either urine bioassay or in vivo analysis was requested from all SRS workers including subcontractor CTWs at termination (DuPont 1991; ORAUT 2017; DuPont 1983–1985). The bioassay results, incident reports, radiation survey logsheets, and air monitoring reports evaluated for this report show that subcontractor CTWs were monitored for intakes of radionuclides routinely, by event-driven sampling, and by termination sampling.

The work locations listed in Job Plans for work performed by subcontractor CTWs were surveyed and swiped for contamination on routine, defined frequencies and intermittently throughout jobs as reported in Attachment B, Table B-2. Similarly, the airborne concentrations of those work locations were continuously monitored for alpha and beta-gamma radioactivity. These data show jobs performed by subcontractor CTWs were monitored in the same manner and with the same procedures as work performed by DuPont CTWs. HP provided protective clothing and respiratory requirements and guidance for all Job Plans before work commenced. HP monitored the work and conditions under all the Job Plans reviewed by the Team for this evaluation. All jobs were monitored at work start-up and were then monitored continuously or intermittently afterwards depending on the work and conditions of the location.

The Team has included examples of subcontractor CTWs involved in contamination incidents, one of which led to a subcontractor CTW being added to the Transuranic Registry. The Team has shown subcontractor CTWs and their clothing, when contaminated or involved in a contamination incident, were surveyed and monitored by HP. More records of such incidents are available. Most of the Job Plan and permit files evaluated for this report did not result in contamination or event-driven bioassay.

The Team finds subcontractor CTWs were monitored for both external and internal radiation exposure by external dosimetry, bioassay, continuous air monitoring, contamination monitoring, and radiation surveys. Work by subcontractor CTWs was preplanned. Instructions for work and protective measures and clothing were specified in the same manner and on the same forms as work to be by DuPont CTWs. Like DuPont CTWs, subcontractor CTWs were monitored in accordance with HP procedures (DuPont 1991). Many subcontractor CTWs, such as the 39% of 88 workers in Table 4-1, were routinely monitored by bioassay. Subcontractor CTWs were also monitored as incidents occurred. While some subcontractor CTWs might not have been monitored by bioassay, the report has shown their coworkers were monitored. As a result, radiation dose to subcontractor CTWs may be reconstructed using external and routine or event-driven bioassay monitoring data available for the worker, using coworker data, or using a combination of the two.

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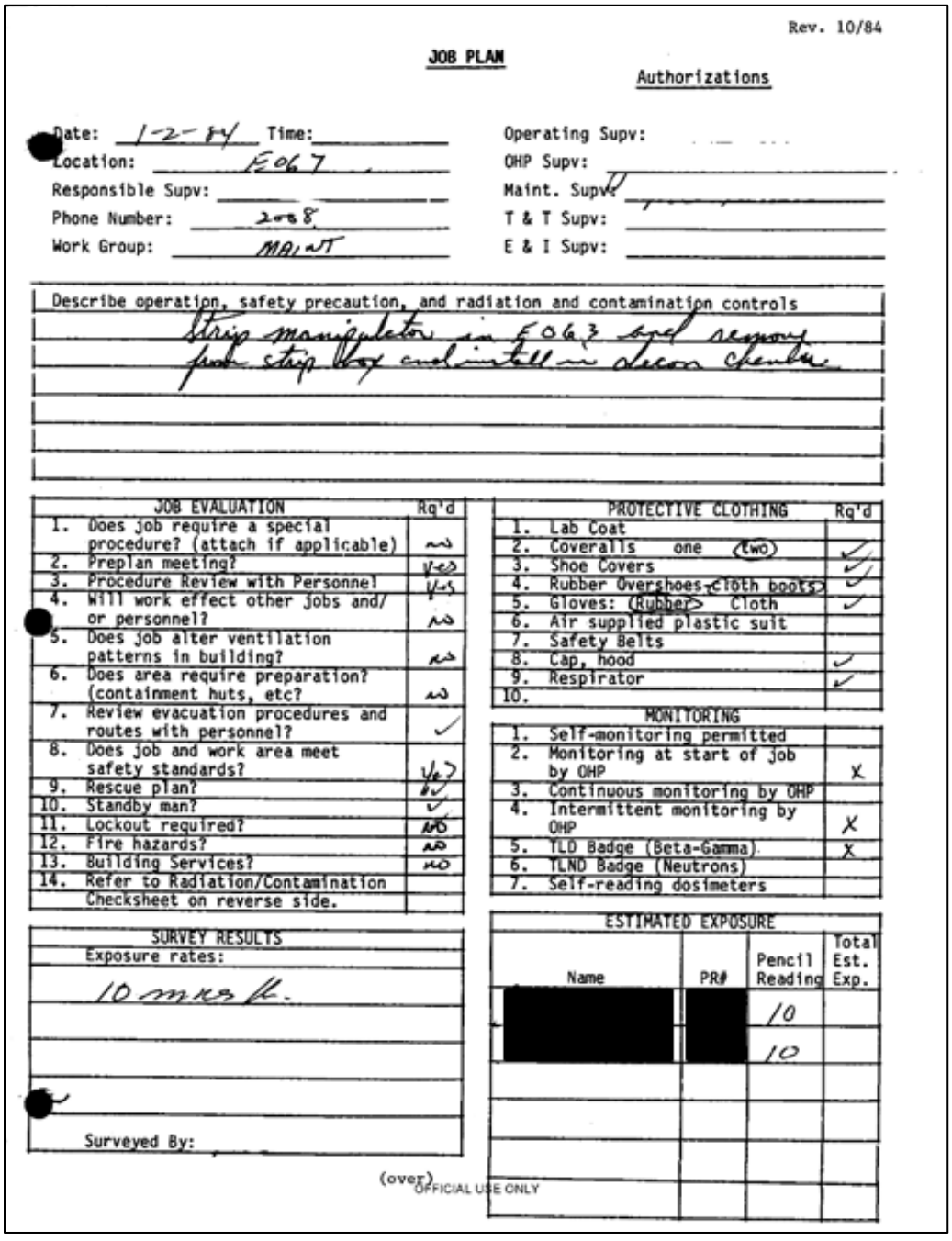
WSRC (Westinghouse Savannah River Company), *Pu Record Book (U.S. Testing), 1986 to 1990*, Savannah River Plant, Aiken, South Carolina. [SRDB Ref ID: 49639]

ATTACHMENT A
TYPES OF FORMS

LIST OF FIGURES

ATTACHMENT A
TYPES OF FORMS (continued)

Four types of forms provided in the Job Plan were reviewed to identify workers. Figure A-1 shows the Job Plan form in the 1980s. Workers from all SRS Rolls, including those subcontractor CTWs who were approved to work on specific jobs, were recorded on this form. The job description, job evaluation, and protective clothing requirements were listed. Note that the protective clothing list also included a respirator. SRS added a supplemental page to the Job Plan form in the mid-1980s.



Rev. 10/84

JOB PLAN

Authorizations

Date: 1-2-84 Time:
Location: F067
Responsible Supv:
Phone Number: 2088
Work Group: MAINT

Operating Supv:
OHP Supv:
Maint. Supv:
T & T Supv:
E & I Supv:

Describe operation, safety precaution, and radiation and contamination controls
Strip manipulator in F063 and remove from strip box and install in decon chamber

JOB EVALUATION	Rq'd
1. Does job require a special procedure? (attach if applicable)	no
2. Preplan meeting?	Yes
3. Procedure Review with Personnel	Yes
4. Will work effect other jobs and/or personnel?	no
5. Does job alter ventilation patterns in building?	no
6. Does area require preparation? (containment huts, etc?	no
7. Review evacuation procedures and routes with personnel?	✓
8. Does job and work area meet safety standards?	Yes
9. Rescue plan?	no
10. Standby man?	✓
11. Lockout required?	no
12. Fire hazards?	no
13. Building Services?	no
14. Refer to Radiation/Contamination Checksheet on reverse side.	

PROTECTIVE CLOTHING	Rq'd
1. Lab Coat	
2. Coveralls one (two)	✓✓
3. Shoe Covers	✓
4. Rubber Overshoes (cloth boots)	✓
5. Gloves: (Rubber) Cloth	✓
6. Air supplied plastic suit	
7. Safety Belts	
8. Cap, hood	✓
9. Respirator	✓
10.	

MONITORING	
1. Self-monitoring permitted	
2. Monitoring at start of job by OHP	X
3. Continuous monitoring by OHP	
4. Intermittent monitoring by OHP	X
5. TLD Badge (Beta-Gamma)	X
6. TLND Badge (Neutrons)	
7. Self-reading dosimeters	

SURVEY RESULTS
Exposure rates:
10 mrad/hr.

Surveyed By:

ESTIMATED EXPOSURE

Name	PR#	Pencil Reading	Total Est. Exp.
[redacted]	[redacted]	10	
		10	

(over)
OFFICIAL USE ONLY

Figure A-1. Example Job Plan (ORAUT 1985b).

ATTACHMENT A
TYPES OF FORMS (continued)

The SWP form (Figure A-2) was used to record subcontractor CTW assignment and monitoring as they worked on a specific job. Job description, instructions, and protection clothing requirements were listed on the permit. Note that certain clothing requirements are in the Instructions section and that the Protective Clothing section includes respirators with check boxes for the type.

OSR 14-8 (Rev. 9-61)

SPECIAL WORK PERMIT

TIME: 8 00 AM / 4 30 PM | BLDG.: 773-A | DATE: 1-2-85 | SWP NO.: 1-4-85

LOCATION: Bldg 773-A, Rms C-077 & C-079

DEPARTMENT(S): Construction

JOB DESCRIPTION: Replace Intermediate Level Cell No. 1 and supportive equipment in Rms C-077 & C-079

SPECIAL INSTRUCTIONS – MONITORING: [X] AT START OF JOB [X] INTERMITTENT [ ] CONTINUOUS

INSTRUCTIONS

WHEN MORE THAN ONE RATE IS LISTED ON SWP, STATE WHICH RATE WAS USED.

ENTER TIME IN RDZ ON TIME SHEET.

HEALTH PHYSICS SHALL BE PRESENT FOR LINE BREAKS.

PERSONAL SURVEY IS REQUIRED WHEN LEAVING RADIATION DANGER ZONE.

[ ] NO PERSONAL OUTER CLOTHING

[X] SPECIAL PROTECTION REQUIRED FOR CUTS OR ABRASIONS.

[ ] TAPE GLOVES-CANVAS BOOTS TO COVERALLS.

[ ] PROVIDE TIMEKEEPER.

[ ] PRE-PLAN MEETING REQUIRED.

[X] CONTACT HEALTH PHYSICS FOR A SURVEY BEFORE STARTING WORK IN A NEW LOCATION.

[ ] PROVIDE ASSISTANCE FOR THE REMOVAL OF PROTECTIVE CLOTHING.

[ ] GIVE BIO-ASSAY SAMPLE BEFORE LEAVING BUILDING.

Additional clothing will be required for line breaks on H+D and the exhaust system.

Personnel should sign in on SWP each Day

PROTECTIVE CLOTHING		EXPOSURE RATE	EXPOSURE UNITS	EXPOSURE DISTANCE	TIME FOR 50 mrem OR 250 µc H³	BODY OR HANDS	SURVEYED BY	TIME
HEAD: CAP / HOOD								
A		3	mr/hr		8 hrs	BODY HANDS		AM PM
FEET: SHOE COVERS	X							
FEET: RUBBERS								
B						BODY HANDS		AM PM
FEET: CANVAS BOOTS								
C						BODY HANDS		AM PM
HANDS: CANVAS GLOVES								
D						BODY HANDS		AM PM
HANDS: RUBBERIZED CANVAS								
HANDS: SURGEONS - SHORT RUBBER								
HANDS: RUBBER GAUNTLET								
BODY: COVERALLS - 1 PAIR 2 PAIR								
BODY: LAB COAT	X							
BODY: SUIT [ ] RUBBER [ ] PLASTIC								
RESP.: [ ] AIR PAK [ ] AIR LINE MASK								
RESP.: ASSAULT MASK								
MET.: FILM BADGE	X							
MET.: PENCILS								

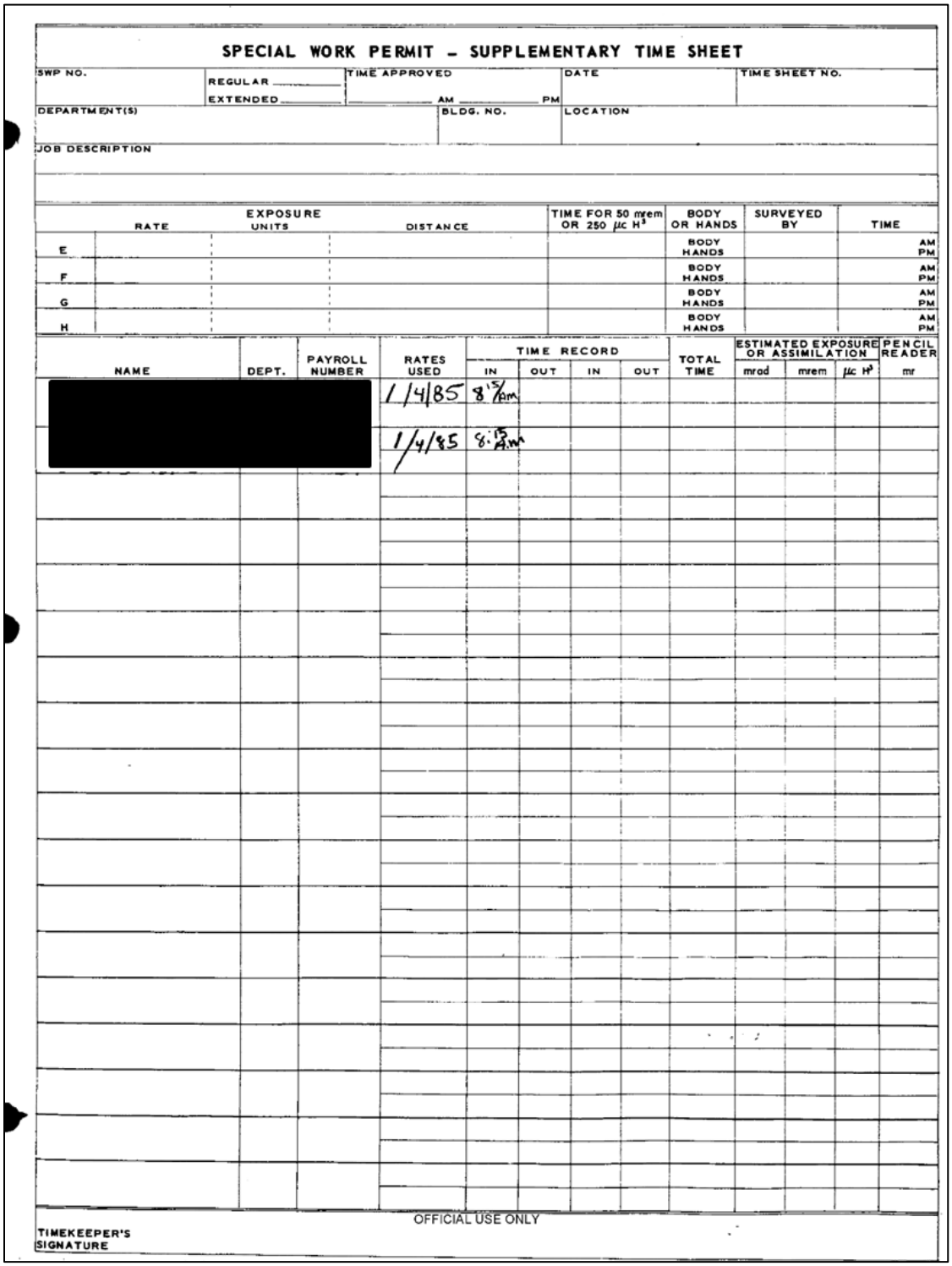
APPROVALS	TO	SHIFT	TO	SHIFT	TO	SHIFT
DIVISION						
HEALTH PHYSICS						
OPERATIONS						
CONSTRUCTION						

NAME	DEPT.	PAYROLL NUMBER	RATES USED	TIME RECORD IN	TIME RECORD OUT	TIME RECORD IN	TIME RECORD OUT	TOTAL TIME	ESTIMATED EXPOSURE OR ASSIMILATION mrem	mrem	µc H³	PENCIL READING mr
[redacted]	[redacted]	[redacted]	1/2/85	8 30	11 30	12 30	4 04					
			1/3/85	8 00			4 00					
			1/2/85	8 20	11:50	12 40	4:04					
			1/3/85	8 00			4 00					
			1-3-85	8 20			409					
			1-4	821			409					
			1-3-85	8 20			409					
			1-4	821			409					
			1-3-85	8 20			409					
			1-4	821			409					

Figure A-2. Example Special Work Permit (ORAUT 1985b).

ATTACHMENT A
TYPES OF FORMS (continued)

Supplementary Time Sheets (Figure A-3) were used to log in additional workers for the SWP. It was associated with the SWP through the SWP number.



SPECIAL WORK PERMIT – SUPPLEMENTARY TIME SHEET

SWP NO. | REGULAR ____ EXTENDED ____ | TIME APPROVED ____ AM ____ PM | DATE | TIME SHEET NO.

DEPARTMENT(S) | BLDG. NO. | LOCATION

JOB DESCRIPTION

	EXPOSURE RATE	EXPOSURE UNITS	DISTANCE	TIME FOR 50 mrem OR 250 μc H³	BODY OR HANDS	SURVEYED BY	TIME
E					BODY HANDS		AM PM
F					BODY HANDS		AM PM
G					BODY HANDS		AM PM
H					BODY HANDS		AM PM

NAME	DEPT.	PAYROLL NUMBER	RATES USED	TIME RECORD IN	TIME RECORD OUT	TIME RECORD IN	TIME RECORD OUT	TOTAL TIME	ESTIMATED EXPOSURE OR ASSIMILATION mrad	mrem	μc H³	PENCIL READER mr
[redacted]			1/4/85	8:15 AM								
			1/4/85	8:15 AM								

OFFICIAL USE ONLY

TIMEKEEPER'S SIGNATURE

Figure A-3. Example Special Work Permit – Supplementary Time Sheet (ORAUT 1985b).

ATTACHMENT A
TYPES OF FORMS (continued)

A Work Clearance Permit (Figure A-4) was used with some Job Plans. The permit provided detail on the safety requirements of the specific job and a written authorization to begin work. This form was often used along with the Job Plan form, but at times SRS appears to have used this form as the only controlling form for a task. These forms were also used for non-radiological work.

OSR 20-103

WORK CLEARANCE PERMIT

The Work Clearance Permit provides detail on the safety requirements of specific jobs and a written authorization to begin work. (Safety Manual Item 32 describes its use)

SAFETY MANUAL REFERENCE	TYPE OF ACTIVITY	SAFETY ANALYSIS REQUIREMENTS
23	☐ Vessel Entry (Attach OSR 20-15)	(1)(2)(5)(6)(7) 8, 15
(25)	☑ Welding and Flame (Use this Form)	1, 2, 3, 4, 5, 7, 15
26	☐ Operation of Equipment Near Overhead Power Lines (Use this Form)	5, 7, 8, 9, 10, 11, 12, 13, 14, 15
27	☐ Excavation or Structure Alteration (Use this Form)	1, 5, 7, 8, 15
27	☐ Railroad or Plant Roadway Clearance (Use this Form)	1, 14, 15
____	☐ Other ____	____

PERMIT TO DO THE FOLLOWING WORK: Weld and Burn as Required – Weld pipe connection on lines in C077- C079.

SAFETY ANALYSIS REQUIREMENTS

☑ 1. Area Roped Off and Posted with Warning Signs	☐ 9. E&I Representative Present	
☑ 2. Standby Fire Extinguisher – Type ____	☐ 10. Crane Properly Positioned	
☐ 3. Fireproof Curtains	☐ 11. Electrical Grounding	
☐ 4. Plastic Hut (Self Extinguishing Material)	☐ 12. 20' Clearance from Electric Lines	
☑ 5. Testing as Indicated Below	☐ 13. Non-conducting Tag Lines	
☑ 6. Lines Drained and Depressurized	☐ 14. Signalman	
☑ 7. Lock, Tag and Try Procedure	☐ 15. Other Special Requirements ____	
☐ 8. Power Source Deenergized		

SPECIAL PROTECTIVE EQUIPMENT (SPECIFY TYPE)
☑ Respiratory Protection
☑ Eye or Face Protection
☑ Protective Clothing
AS Required

TESTS REQUIRED	FREQUENCY	INITIAL RESULT
☐ Oxygen		
☑ Explosibility	Prior to Job	
☐ Health Physics Monitoring		
☑ Other IF WORK CHANGES		

SERVICING SUPERVISOR(S) IN CHARGE OF WORK

APPROVALS (ENTER NA WHEN APPROVAL NOT REQUIRED)					
CUSTODIAN [redacted]	MAINTENANCE N/A	E&I N/A	T&T N/A	HEALTH PHYSICS	
POWER N/A	PATROL N/A	SECURITY N/A	PROJECT N/A	FIRE PROTECTION N/A	

ALL PERSONNEL WORKING ON THIS ASSIGNMENT SHALL READ THIS ANALYSIS AND INITIAL BELOW IF THEY CONCUR THAT THE SAFETY REQUIREMENTS HAVE BEEN COMPLETED.

NAME/DEPARTMENT	NAME/DEPARTMENT	NAME/DEPARTMENT	NAME/DEPARTMENT
[redacted]			

WORK CLEARANCE AUTHORIZATION WORK REQUEST NUMBER

RENEWAL FREQUENCY
____ SHIFT
____ ✓ DAILY
____ OTHER

[redacted]

NOTE: WORK CLEARANCE PERMIT MUST BE APPROVED PRIOR TO START OF WORK

Figure A-4. Example Work Clearance Permit (ORAUT 1985b).

ATTACHMENT A
TYPES OF FORMS (continued)

The Confined Space and Vessel Entry Log was used with tasks that required confined space entry. The first page provided reason, work description and instructions, entry preparation, protective equipment, preventive measures, and approvals for entry of confined space. The second page (Figure A-5), was used to log entry of workers.

CONFINED SPACE AND VESSEL ENTRY LOG

VESSEL NAME & NUMBER

AREA & BUILDING

NAME (PERSON ENTERING)	DATE	TIME IN (INITIAL)	TIME OUT (INITIAL)

OFFICIAL USE ONLY

Figure A-5. Confined Space and Vessel Entry Log (ORAUT 1985b).

ATTACHMENT B
JOB DESCRIPTIONS

LIST OF TABLES

ATTACHMENT B
JOB DESCRIPTIONS (continued)

Tables B-1 and B-2 document the findings from review of the Job Plans, workplace monitoring, and worker bioassay data associated with the 133 distinct subcontractor CTW-job pairings and their bioassay data.

Table B-1 provides descriptive data for each Job Plan. The table lists the date of the Job Plan, the craft of subcontractor CTW, and a description of the task to be done. Job Plans were numbered in date order. Table B-2 provides, in the same date order, workplace conditions, respiratory requirements, and accounting of bioassay results for subcontractor CTW matched to the Job Plan. A subcontractor CTW was marked as being sampled for a particular radionuclide if the sampling time difference was less than or equal to the frequency for the radionuclide for Building 773-A in DuPont (1971). SRS HP procedures were used uniformly across SRS during the time of this evaluation. Therefore, workers on routine bioassay were sampled in the area assigned at the time the bioassay was requested. Additionally, subcontractor CTWs might have been sampled in relation to work in other areas. Certain workers might have worked in other areas at SRS during the same year they worked under a Job Plan or permit at Building 773-A. Some bioassays might have been a result of that work and unrelated to the plans and permits for Building 773-A, but results of that bioassay sampling might still bound intakes from work in Building 773-A.

Table B-1. Descriptions of jobs by selected CTW.

No.	Craft	Job Plan Date	Task
1	Pipefitter	01/04/1980	Cut pipe (liquid) in Co-60 cell
2	Sheet Metal	07/15/1980	Remove glovebox from B-147
3	Laborer	07/15/1980	Remove glovebox from B-147
4	Pipefitter	02/16/1981	Install HLD in B-005
5	Construction	03/05/1981	Remove/replace contaminated exhaust duct at CPF
6	Pipefitter	03/05/1981	Remove/replace contaminated exhaust duct at CPF
7	Sheet Metal	03/05/1981	Remove/replace contaminated exhaust duct at CPF
8	Construction	03/05/1981	Remove/replace contaminated exhaust duct at CPF
9	Heavy Equipment Operator	03/05/1981	Remove/replace contaminated exhaust duct at CPF
10	Pipefitter	03/05/1981	Remove/replace contaminated exhaust duct at CPF
11	Construction	03/05/1981	Remove/replace contaminated exhaust duct at CPF
12	Ironworker	03/05/1981	Remove/replace contaminated exhaust duct at CPF
13	Construction	03/05/1981	Remove/replace contaminated exhaust duct at CPF
14	Pipefitter	03/05/1981	Remove/replace contaminated exhaust duct at CPF
15	Pipefitter	04/20/1981	Install HLD in B-005
16	Pipefitter	04/20/1981	Install HLD in B-005 (tritium worker)
17	Construction	09/24/1981	Remove, cut scaffolding in B-005
18	Construction	11/03/1981	Clean up tent in from of cells 10-12.
19	Heavy Equipment Operator	11/18/1981	Install window frames in cells 10-12
20	Concrete Worker	02/18/1982	Pour concrete around cells 10-12
21	Concrete Worker	02/18/1982	Pour concrete around cells 10-12
22	Concrete Worker	02/22/1982	Pour concrete around cells 10-12
23	Construction	02/26/1982	Pour concrete around cells 10-12
24	Pipefitter	08/25/1982	Connect AD&D OGE line to header in trench
25	Pipefitter	08/25/1982	Connect AD&D OGE line to header in trench
26	Electrician	03/11/1983	Install electrical conduit for Cell 11 in F-091
27	Pipefitter	03/16/1983	Entry to area to mark layout for drain line work (C-005)
28	Pipefitter	03/16/1983	Entry to area to mark layout for drain line work (C-005)
29	Pipefitter	03/29/1983	Construction layout for future pipe cuts
30	Pipefitter	03/29/1983	Construction layout for future pipe cuts

ATTACHMENT B
JOB DESCRIPTIONS (continued)

No.	Craft	Job Plan Date	Task
31	Painter	07/30/1983	Paint floors in E-001, E-002, E-004, and E-008
32	Painter	07/30/1983	Paint floors in E-001, E-002, E-004 and E-008
33	Iron Worker	08/09/1983	Tie filter housing into C-059 exhaust (tritium worker)
34	Sheet Metal	09/14/1983	Line break, C-005
35	Painter	09/16/1983	Painting in HLC (E-043, E-076)
36	Painter	09/16/1983	Painting in HLC (E-043, E-076) (H3 worker)
37	Carpenter	10/06/1983	Install temporary line in C-077
38	Ironworker	10/27/1983	Disassembly of airlock in C-077
39	Construction	10/27/1983	Disassembly of airlock in C-077
40	Ironworker	10/27/1983	Disassembly of airlock in C-077
41	Sheet Metal	11/01/1983	Construct liner in ILC
42	Pipefitter	11/02/1983	Remove tank cells and evaporator in ILC
43	Millwright	11/14/1983	Remove polyvinylchloride tenting associated with ILC
44	Pipefitter	11/22/1983	Connect decon line to cell service over TFF (F-091)
45	Construction	11/29/1983	General work in ILC (tritium worker)
46	Millwright	02/20/1984	Install walls and electrical service for Office E-064
47	Carpenter	03/17/1984	Erect scaffolding in E Wing high bay area
48	Carpenter	03/17/1984	Erect scaffolding in E Wing high bay area
49	Carpenter	03/17/1984	Erect scaffolding in E Wing high bay area
50	Electrician	03/19/1984	Replace bus on HLC crane (E-055)
51	Electrician	03/19/1984	Replace bus on HLC crane (E-055)
52	Electrician	03/19/1984	Replace bus on HLC crane (E-055)
53	Electrician	03/19/1984	Replace bus on HLC crane (E-055)
54	Carpenter	03/19/1984	Replace bus on HLC crane (E-055) (tritium worker)
55	Electrician	03/19/1984	Replace bus on HLC crane (E-055)
56	Electrician	03/19/1984	Replace bus on HLC crane (E-055)
57	Electrician	03/20/1984	Replace bus on HLC crane (E-055)
58	Electrician	03/20/1984	Replace bus on HLC crane (E-055)
59	Painter	03/20/1984	Paint HLC crane (E-055)
60	Electrician	03/26/1984	Replace bus on HLC crane (E-055)
61	Painter	03/30/1984	Paint HLC crane (E-055)
62	Pipefitter	04/17/1984	Remove two vacuum lines from CPF cell #1
63	Painter	04/26/1984	Spray inside glovebox with window spray to dampen surface
64	Laborer	05/10/1984	Run cable trays and cable in F-102 to F-091
65	Radiographer	05/18/1984	X-ray pipe welds, C-005
66	Radiographer	05/18/1984	X-ray pipe welds, C-005 (tritium worker)
67	Electrician	05/30/1984	Cut holes in walls of E-072; E-073 and E-075
68	Electrician	05/30/1984	Cut holes in walls of E-072; E-073 and E-075
69	Electrician	09/04/1984	Replace intermediate level cell #1 in C-077 and C-079
70	Millwright	10/15/1984	Replace intermediate level cell #1 in C-077 and C-079
71	Millwright	10/29/1984	Replace intermediate level cell #1 in C-077 and C-079
72	Pipefitter	12/17/1984	Replace intermediate level cell #1 in C-077 and C-079
73	Boilermaker	12/26/1984	Replace intermediate level cell #1 in C-077 and C-079
74	Boilermaker	12/26/1984	Replace intermediate level cell #1 in C-077 and C-079
75	Boilermaker	01/02/1985	Replace intermediate level cell #1 in C-077 and C-079
76	Pipefitter	01/02/1985	Replace intermediate level cell #1 in C-077 and C-079
77	Electrician	01/18/1985	Check-out fan motors for MCC 5 & 5E start-up, rooms B-031 & B-001
78	Electrician	01/18/1985	Check-out fan motors for MCC 5 & 5E start-up, rooms B-031 & B-001
79	Electrician	01/18/1985	Check-out fan motors for MCC 5 & 5E start-up, rooms B-031 & B-001

ATTACHMENT B
JOB DESCRIPTIONS (continued)

No.	Craft	Job Plan Date	Task
80	Boilermaker	03/11/1985	Replace intermediate level cell #1 in C-077 and C-079
81	Electrician	03/18/1985	Replace intermediate level cell #1 in C-077 and C-079
82	Painter	03/29/1985	Paint and repair six rooms in E Wing
83	Painter	03/29/1985	Paint and repair six rooms in E Wing (loaned from C area)
84	Construction	04/14/1985	Work on MCC 21E & 22E
85	Electrician	04/14/1985	Install HVAC systems on D Wing, E Wing roofs
86	Pipefitter	04/14/1985	Install HVAC systems on D Wing, E Wing roofs
87	Pipefitter	04/14/1985	Install HVAC systems on D Wing, E Wing roofs
88	Pipefitter	07/01/1985	Supply process water line to core 3 in. holes for new HLD line
89	Pipefitter	07/16/1985	Work on B-111 high level drain
90	Carpenter	07/24/1985	Remove piping from around TFF
91	Pipefitter	07/24/1985	Remove piping from around TFF
92	Construction	07/25/1985	Remove existing ladder to north E Wing roof, install stairway (tritium worker)
93	Ironworker	07/28/1985	Remove gloveboxes D, E, and G
94	Carpenter	07/29/1985	Work on high-level drain in B-105, B-111, and B-165
95	Pipefitter	07/29/1985	Work on high-level drain in B-105, B-111, and B-165
96	Millwright	08/08/1985	Remove TFF tubes
97	Carpenter	08/20/1985	Construct platform in F-091
98	Ironworker	08/21/1985	Remove duct from tent and place in bag (F-091, F-092)
99	Carpenter	08/22/1985	Install catch pan for core drilling in C-005
100	Carpenter	08/22/1985	Install catch pan for core drilling in C-005
101	Carpenter	08/26/1985	Remove tubing from on high-level drain in C-135/C-139
102	Carpenter	08/28/1985	Remove aux. vent duct from TFF
103	Laborer	08/28/1985	Remove aux. vent duct from TFF
104	Laborer	08/30/1985	Relocated scaffolding in C-005; core drill for C-135/C-139
105	Laborer	08/30/1985	Relocated scaffolding in C-005; core drill for C-135/C-139
106	Boilermaker	09/05/1985	Replace intermediate level cell #1 in C-077 and C-079
107	Pipefitter	09/06/1985	Break process water line going to HL flush, C-005
108	Ironworker	09/13/1985	Cut away iron work at north wall
109	Boilermaker	09/16/1985	Replace intermediate level cell #1 in C-077 and C-079
110	Laborer	10/11/1985	Remove materials, excess waste in B-005
111	Pipefitter	10/23/1985	Replace intermediate level cell #1 in C-077 and C-079
112	Electrician	10/23/1985	Replace intermediate level cell #1 in C-077 and C-079
113	Millwright	10/23/1985	Replace intermediate level cell #1 in C-077 and C-079
114	Electrician	11/04/1985	Replace intermediate level cell #1 in C-077 and C-079
115	Boilermaker	11/07/1985	Replace intermediate level cell #1 in C-077 and C-079
116	Pipefitter	11/25/1985	Remove and cut pipe in cell A, TFF
117	Pipefitter	12/02/1985	Replace intermediate level cell #1 in C-077 and C-079
118	Electrician	01/07/1986	Connect HLD in C-077 (tritium worker)
119	Pipefitter	01/07/1986	Connect HLD in C-077
120	Pipefitter	03/13/1986	Connect HLD in C-077
121	Driver	04/03/1986	Associated with work at the TFF
122	Ironworker	05/12/1986	Remove metal from F-091 catwalk
123	Boilermaker	07/14/1986	Cut TFF line to water tanks for F-091
124	??????	07/14/1986	Cut TFF line to water tanks for F-091
125	Pipefitter	11/13/1986	Drill holes in concrete support columns; install hangers (B-005, C-005)
126	Pipefitter	11/25/1986	Enter B-005 to take measurements for breathing air line
127	Pipefitter	11/25/1986	Enter B-005 to take measurements for breathing air line
128	Electrician	11/26/1986	Drill holes in concrete support columns; install hangers (B-005, C-005)

ATTACHMENT B
JOB DESCRIPTIONS (continued)

No.	Craft	Job Plan Date	Task
129	Pipefitter	12/01/1986	Work on breathing airline in C-005
130	Carpenter	12/04/1986	Fabrication of entry room to C-005
131	Carpenter	12/08/1986	Fabrication of entry room to C-005
132	Pipefitter	12/09/1986	Drill holes in concrete support columns; install hangers (B-005, C-005)
133	Radiographer	12/15/1986	X-ray welds in C-005

ATTACHMENT B
JOB DESCRIPTIONS (continued)

1 Table B-2. Monitoring data for subcontractors identified on Job Plans. (Areas where samples were collected are shown in parentheses).[a]

No.	Job plan date	Respirator required	α air concentration (10^{-12} µCi/cm^3)	Fission product air concentration (10^{-12} µCi/cm^3)	HP[b]	Plutonium	Fission products	In vivo
1	01/04/1980	Yes	Not available	Not applicable	C	05/01/1983 (A)[c]	10/10/1980 (M)[c]	None
2	07/15/1980	Yes	Not applicable	Not applicable	C	10/15/1980[d]	None	None
3	07/15/1980	Yes	Not applicable	Not applicable	I	10/15/1980[d]	None	None
4	02/16/1981	No	<1.0	<1.0	I	01/31/1984 (A)	01/14/1982 (L)[c]	05/04/1981
5	03/05/1981	Yes	<1.0	<1.0	I	12/18/1981 (C)	12/18/81 (C)	None
6	03/05/1981	Yes	<1.0	<1.0	I	12/18/1981[d]	03/16/1981 (A)	05/14/1981
7	03/05/1981	Yes	<1.0	<1.0	I	12/18/1981[d]	06/01/1981 (F)	None
8	03/05/1981	Yes	<1.0	<1.0	I	12/18/1981[d]	06/01/1981[d]	None
9	03/05/1981	Yes	<1.0	<1.0	I	12/18/1981[d]	06/01/1981[d]	None
10	03/05/1981	Yes	<1.0	<1.0	I	12/18/1981[d]	06/01/1981[d]	None
11	03/05/1981	Yes	<1.0	<1.0	I	12/18/1981[d]	06/01/1981[d]	None
12	03/05/1981	Yes	<1.0	<1.0	I	12/18/1981[d]	05/07/1982 (A)	None
13	03/05/1981	Yes	<1.0	<1.0	I	12/18/1981[d]	06/1/1981[d]	None
14	03/05/1981	Yes	<1.0	<1.0	I	09/03/1982 (A)	09/18/1981 (A)[c]	05/12/1981
15	04/20/1981	Yes	2.4[e]	<1.0	I	05/01/1983 (A)[c]	05/19/1982 (A)[c]	05/13/1981
16	04/20/1981	Yes	2.4[e]	<1.0	I	05/01/1983 (A)[d]	05/19/1982 (A)[d]	10/25/1982
17	09/24/1981	Yes	<1.0	<1.0	S	08/09/1983(L)[c]	08/19/1982 (A)[c]	None
18	11/03/1981	Yes	<1.0	<1.0	I	08/23/1982 (A)[c]	08/23/1982 (A)[c]	None
19	11/18/1981	Yes	<1.0	<1.0	I	01/29/1982 (CS)	01/28/1982 (A)	None
20	02/18/1982	Yes	<1.0	<1.0	I	01/12/1983 (L)	01/12/1983 (L)[c]	None
21	02/18/1982	Yes	<1.0	<1.0	I	01/12/1983 (L)[d]	03/29/1982 (C)[c]	None
22	02/22/1982	Yes	<1.0	<1.0	I	01/12/1983 (L)[d]	03/29/1982 (A)[c]	None
23	02/26/1982	Yes	<1.0	<1.0	I	08/09/1983 (L)[c]	08/19/1982 (A)[c]	None
24	08/25/1982	Yes	<1.0	<1.0	C	08/29/1984 (M)[c]	08/29/1984 (M)[c]	None
25	08/25/1982	Yes	<1.0	<1.0	C	08/29/1984[d]	05/09/1983(A)[d]	None
26	03/11/1983	Yes	<1.0	<1.0	I	11/12/1983 (A)[d]	08/30/1983[d]	11/30/1985
27	03/16/1983	No	<1.0	<1.0	C	08/24/1983[d]	05/09/1983 (A)[d]	None
28	03/16/1983	No	<1.0	<1.0	C	08/24/1983[d]	05/09/1983 (A)[c]	None
29	03/29/1983	No	<1.0	<1.0	C	05/17/1985 (F)[c]	05/05/1983 (H)[c]	None
30	03/29/1983	No	<1.0	<1.0	C	05/17/1985 (F)[d]	05/05/1983 (H)[d]	None
31	07/30/1983	Yes	<1.0	<1.0	I	None	12/31/1983[d]	None
32	07/30/1983	Yes	<1.0	<1.0	I	None	12/31/1983 (A)[c]	None
33	08/09/1983	Yes	<1.0	<1.0	C	None	None	None
34	09/14/1983	Yes	<1.0	<1.0	S	None	10/12/1983 (C)	None

ATTACHMENT B
JOB DESCRIPTIONS (continued)

No.	Job plan date	Respirator required	α air concentration (10^{-12} µCi/cm^3)	Fission product air concentration (10^{-12} µCi/cm^3)	HP[b]	Plutonium	Fission products	In vivo
35	09/16/1983	Yes	<1.0	<1.0	I	11/17/1983[d]	09/22/1983 (A)	None
36	09/16/1983	Yes	<1.0	<1.0	I	11/17/1983[d]	09/22/1983[d]	None
37	10/06/1983	Yes	<1.0	<1.0	C	01/11/1985[d]	09/24/1984 (A)[d]	None
38	10/27/1983	Yes	10.3[e]	<1.0	C	01/11/1985[d]	08/08/1984[d]	None
39	10/27/1983	Yes	10.3[e]	<1.0	C	08/08/1984 (A)[c]	08/08/1984 (A)[c]	None
40	10/27/1983	Yes	10.3[e]	<1.0	C	08/08/1984[d]	08/08/1984[d]	None
41	11/01/1983	Yes	<1.0	<1.0	C	02/03/1984 (C)	04/04/1983[d]	None
42	11/02/1983	Yes	<1.0	<1.0	C	05/11/1984 (A)[c]	05/11/1984 (A)[c]	None
43	11/14/1983	Yes	<1.0	<1.0	I	02/14/1984 (H)	02/14/1984 (H)	None
44	11/22/1983	No	<1.0	<1.0	I	02/01/1985 (A)[c]	12/27/1984 (A)[c]	None
45	11/29/1983	No	1	<1.0	I	None	None	None
46	02/20/1984	No	<1.0	<1.0	I	03/21/1984 (F)[c]	03/21/1984 (F)[c]	None
47	03/17/1984	Yes	<1.0	2.9	I	11/13/1985 (F)[c]	11/7/1984 (M)[c]	None
48	03/17/1984	Yes	<1.0	2.9	I	11/13/1985[d]	09/24/1984 (A)[d]	None
49	03/17/1984	Yes	<1.0	2.9	I	08/13/1987 (F)	09/24/1984 (A)[c]	None
50	03/19/1984	No	<1.0	<1.0	I	03/06/1986 (A)[c]	03/23/1984 (A)[c]	None
51	03/19/1984	No	<1.0	<1.0	I	03/06/1986[d]	03/23/1984[d]	None
52	03/19/1984	No	<1.0	<1.0	I	04/23/1984 (A)[d]	04/23/1984 (A)[d]	None
53	03/19/1984	No	<1.0	<1.0	I	04/23/1984[d]	07/16/1984 (A)	None
54	03/19/1984	No	<1.0	<1.0	I	04/03/1985 (A)[c]	04/06/1984 (P)	None
55	03/19/1984	No	<1.0	<1.0	I	04/03/1985 (A)[c]	09/16/1984 (C)	None
56	03/19/1984	No	<1.0	<1.0	I	04/03/1985[d]	04/06/1984[d]	None
57	03/20/1984	No	<1.0	<1.0	I	04/23/1984 (A)	04/23/1984 (A)	10/14/1985
58	03/20/1984	No	<1.0	<1.0	I	04/23/1984[d]	07/16/1984 (A)[d]	None
59	03/20/1984	Yes	<1.0	<1.0	I	08/14/1984 (C)	11/26/1984 (C)	None
60	03/26/1984	No	<1.0	<1.0	I	10/04/1984 (A)	10/04/1984 (A)	None
61	03/30/1984	Yes	<1.0	<1.0	I	08/14/1984[d]	11/26/1984[d]	None
62	04/17/1984	Yes	<1.0	<1.0	C	05/20/1984 (A)	05/20/1984 (A)[c]	None
63	04/26/1984	Yes	<1.0	<1.0	C	01/07/1985 (G)[c]	01/07/1985 (G)[c]	None
64	05/10/1984	No	<1.0	<1.0	S	08/08/1984 (A)[c]	08/08/1984 (A)[c]	11/04/1986
65	05/18/1984	Yes	<1.0	<1.0	C	05/30/1984 (CS)[c]	05/30/1984 (CS)[c]	None
66	05/18/1984	Yes	<1.0	<1.0	C	05/30/1984[d]	05/30/1984[d]	None
67	05/30/1984	Yes	<1.0	<1.0	I	None	None	None
68	05/30/1984	Yes	<1.0	<1.0	I	None	None	None
69	09/04/1984	No	<1.0	<1.0	S	None	06/14/1985 (A)[d]	None

ATTACHMENT B
JOB DESCRIPTIONS (continued)

No.	Job plan date	Respirator required	α air concentration (10^{-12} µCi/cm^3)	Fission product air concentration (10^{-12} µCi/cm^3)	HP[b]	Plutonium	Fission products	In vivo
70	10/15/1984	No	<1.0	<1.0	S	04/29/1985 (A)	04/29/1985 (A)[c]	01/17/1987
71	10/29/1984	No	<1.0	<1.0	S	04/29/1985[d]	04/29/1985[d]	None
72	12/17/1984	No	<1.0	<1.0	S	None	None	None
73	12/26/1984	No	<1.0	<1.0	S	06/20/1986 (CS)	None	None
74	12/26/1984	No	<1.0	<1.0	S	06/20/1986[d]	None	None
75	01/02/1985	No	<1.0	<1.0	S	06/20/1986[d]	06/20/1986 (CS)	None
76	01/02/1985	No	<1.0	<1.0	S	06/20/1986[d]	01/15/1986 (A)[c]	11/03/1987
77	01/18/1985	Yes	<1.0	<1.0	I	04/11/1985 (A)	09/11/1986[d]	08/15/1987
78	01/18/1985	Yes	<1.0	<1.0	I	04/11/1985[d]	09/11/1986 (CS)	None
79	01/18/1985	Yes	<1.0	<1.0	I	05/08/1986 (F)[c]	05/19/1985 (A)[c]	01/27/1986
80	03/11/1985	No	<1.0	<1.0	I	11/06/1985	None	None
81	03/18/1985	No	<1.0	<1.0	I	11/06/1985	None	None
82	03/29/1985	No	<1.0	<1.0	I	04/05/1985 (F)[c]	03/18/1986 (F)[c]	01/27/1988
83	03/29/1985	No	<1.0	<1.0	I	None	None	None
84	04/14/1985	No	<1.0	<1.0	I	None	None	None
85	04/14/1985	No	<1.0	<1.0	I	None	None	None
86	04/14/1985	No	<1.0	<1.0	I	None	None	None
87	04/14/1985	No	<1.0	<1.0	I	None	None	None
88	07/01/1985	Yes	<1.0	<1.0	I	05/06/1988 (CS)	None	09/10/1987
89	07/16/1985	Yes	<1.0	<1.0	C	05/15/1987 (A)[c]	04/21/1986 (A)[c]	None
90	07/24/1985	Yes	<1.0	<1.0	I	10/25/1985 (H)	10/25/1985 (H)	None
91	07/24/1985	Yes	<1.0	<1.0	I	10/25/1985[d]	10/25/1985[d]	None
92	07/25/1985	No	<1.0	<1.0	I	None	12/09/1985[d]	08/26/1987
93	07/28/1985	Yes	<1.0	<1.0	C	10/28/1985 (M)[d]	12/09/1985 (C)	None
94	07/29/1985	Yes	<1.0	<1.0	I	02/26/1986 (F)[c]	09/20/1985 (A)	02/25/1986
95	07/29/1985	Yes	<1.0	<1.0	I	02/26/1986[d]	01/26/1986 (A)[c]	None
96	08/08/1985	Yes	<1.0	<1.0	I	04/16/1987 (C)[c]	05/13/1986 (C)[c]	06/17/1987
97	08/20/1985	No	<1.0	<1.0	S	04/16/1987 (A)[c]	04/04/1986 (A)[c]	None
98	08/21/1985	Yes	<1.0	<1.0	I	12/20/1989 (CS)	None	None
99	08/22/1985	Yes	<1.0	<1.0	I	04/21/1988 (F)	04/04/1986 (A)[c]	01/24/1987
100	08/22/1985	Yes	<1.0	<1.0	I	04/21/1988[d]	04/04/1986[d]	None
101	08/26/1985	Yes	<1.0	<1.0	C	12/09/1987 (F)	12/12/1985 (A)[c]	12/23/1987
102	08/28/1985	Yes	<1.0	<1.0	C	10/25/1985 (H)[c]	10/25/1985 (H)[c]	08/08/1987
103	08/28/1985	Yes	<1.0	<1.0	C	10/25/1985[d]	10/25/1985[d]	11/01/1987
104	08/30/1985	Yes	<1.0	<1.0	C	01/21/1987 (G)	02/25/1986 (F)[c]	07/25/1987

ATTACHMENT B
JOB DESCRIPTIONS (continued)

No.	Job plan date	Respirator required	α air concentration (10^{-12} µCi/cm^3)	Fission product air concentration (10^{-12} µCi/cm^3)	HP[b]	Plutonium	Fission products	In vivo
105	08/30/1985	Yes	<1.0	<1.0	C	07/26/1988 (L)	02/25/1986[d]	07/22/1987
106	09/05/1985	No	<1.0	<1.0	I	11/14/1987[d]	None	None
107	09/06/1985	Yes	<1.0	<1.0	I	None	04/15/1986 (A)[c]	None
108	09/13/1985	Yes	<1.0	<1.0	I	11/25/1987 (H)[c]	03/06/1986 (H)[c]	03/03/1988
109	09/16/1985	No	<1.0	<1.0	I	01/29/1986[d]	None	None
110	10/11/1985	Yes	<1.0	<1.0	S	12/09/1987 (F)[d]	12/12/1985 (A)[d]	None
111	10/23/1985	No	<1.0	<1.0	I	01/29/1986[d]	12/18/1985 (A)	None
112	10/23/1985	No	<1.0	<1.0	I	01/29/1986[d]	07/09/1986 (K)	None
113	10/23/1985	No	<1.0	<1.0	I	10/10/1988 (H)	01/15/1986[d]	09/03/1988
114	11/04/1985	No	<1.0	<1.0	I	02/09/1986[d]	None	02/29/1988
115	11/07/1985	No	<1.0	<1.0	I	02/09/1986 (F)	None	None
116	11/25/1985	Yes	<1.0	<1.0	C	01/17/1986 (A)	None	None
117	12/02/1985	No	<1.0	<1.0	I	08/15/1986 (A)[c]	08/15/1986 (A)	None
118	01/07/1986	Yes	<1.0	<1.0	C	04/03/1986 (A)[c]	04/03/1986 (A)[c]	None
119	01/07/1986	Yes	<1.0	<1.0	C	04/03/1986 (A)[d]	04/03/1986 (A)[d]	None
120	03/13/1986	Yes	<1.0	<1.0	C	08/15/1986 (A)[c]	08/15/1986 (A)	07/21/1987
121	04/03/1986	Yes	<1.0	<1.0	C	None	None	06/07/1988
122	05/12/1986	Yes	<1.0	<1.0	I	06/10/1987 (A)	06/10/1986 (A)	06/01/1988
123	07/14/1986	Yes	<1.0	<1.0	I	08/15/1986 (F)	08/15/1986 (F)	None
124	07/14/1986	Yes	<1.0	<1.0	I	09/26/1986 (A)	09/26/1986 (A)	None
125	11/13/1986	Yes	<1.0	<1.0	I	08/27/1987 (H)	08/27/1987 (H)	06/01/1987
126	11/25/1986	Yes	<1.0	<1.0	I	08/10/1987 (A)[c]	08/15/1987 (A)[c]	09/14/1987
127	11/25/1986	Yes	<1.0	<1.0	I	08/10/1987[d]	08/15/1987[d]	02/24/1988
128	11/26/1986	Yes	<1.0	<1.0	I	10/23/1989 (A)	None	12/04/1989
129	12/01/1986	Yes	<1.0	<1.0	I	08/10/1987[d]	02/25/1987 (H)	None
130	12/04/1986	Yes	2.3[e]	<1.0	I	04/16/1987 (H)	04/16/1987 (H)	01/19/1988
131	12/08/1986	Yes	2.8[e]	<1.0	I	04/16/1987[d]	04/09/1987 (A)	09/16/1987
132	12/09/1986	Yes	1.9[e]	<1.0	I	05/22/1990 (K)	None	09/12/1988
133	12/15/1986	Yes	25.5[e]	<1.0	I	06/25/1987 (H)[c]	06/25/1987 (H)[c]	07/01/1987

a. Certain workers might have worked in other areas at SRS during the same year as they worked under a Job Plan or permit at Building 773-A. Some bioassays might have been a result of that work and unrelated to the plans and permits for Building 773-A.
b. HP monitoring: S = start of job, I = intermittent, C = continuous.
c. Routine bioassay sample.
d. Result from another coworker on same job.
e. Respiratory protection used.