Savannah River Site Special Exposure Cohort Petition Evaluation

Radiological Monitoring for Neptunium

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Overview

- Neptunium Processes at Savannah River Site (SRS)
- Radiological Controls at SRS
  - Special Hazards Bulletins
  - DPSOP-40
- Personnel Monitoring for Neptunium
  - Bioassay
  - Whole body Counting
- Neptunium Co-worker Model *(ORAUT-OTIB-0081)*
- A Comparison of Co-worker models for Neptunium *(ORAUT-RPRT-0056)*

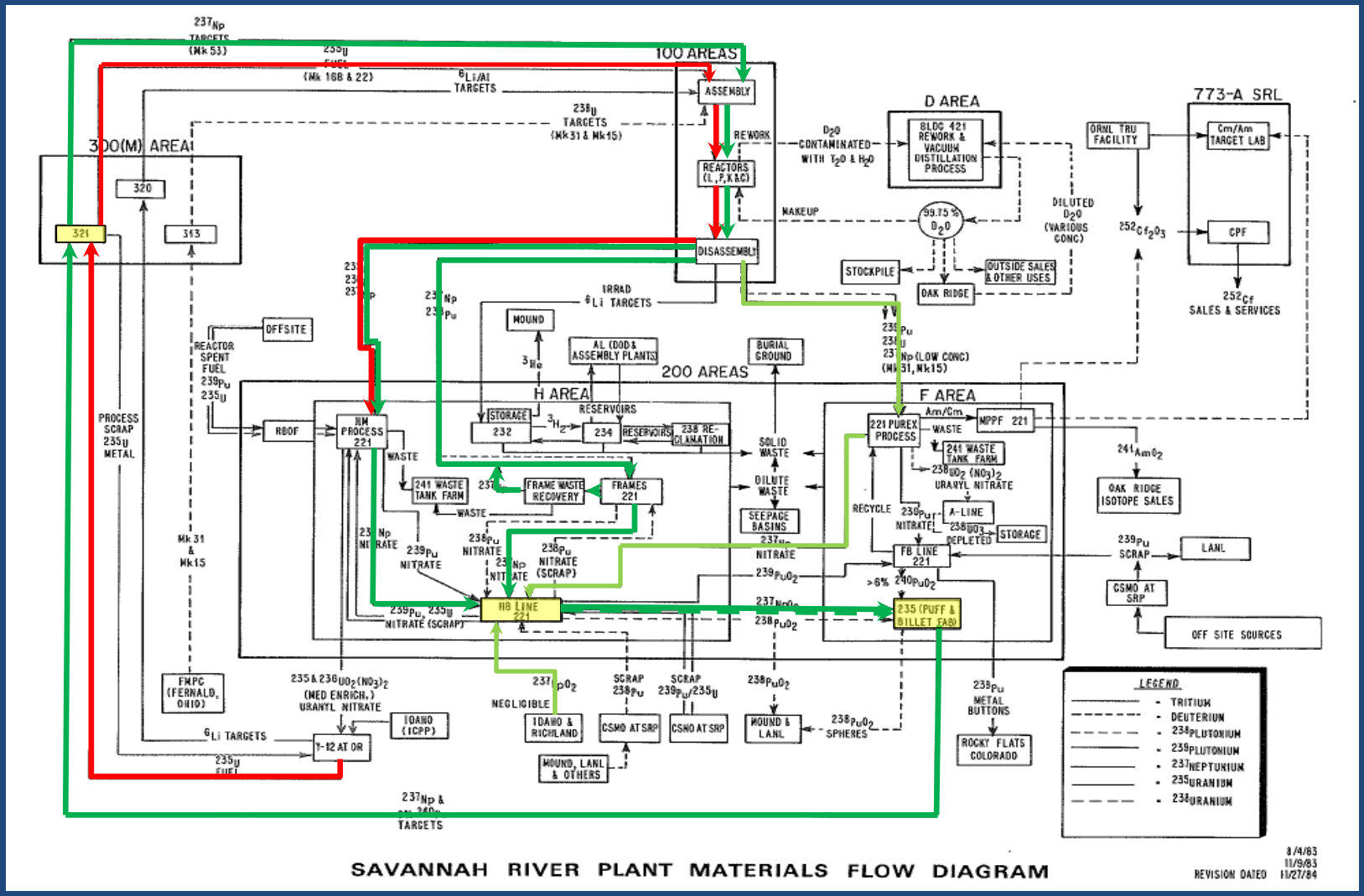
Neptunium Processes at SRS

- ***Overall Goal was the production of Pu-238***
  Np-237 (n, γ) Np-238 → Pu-238

- **Production started in 1961**
- **Production ended in July 1984**

- **Main Processes involving Np**
  - **Manufacture Np targets (200 and 300 area)**
  - **Irradiate targets in reactors (100 area)**
  - **Chemical Separation of Pu-238 from Np (200 area)**

Neptunium Flow Diagram



HB-Line Np Process

- Mission: Conversion of Np nitrate to Np oxide
- ABRWH toured HB-Line in 2010
- Two main sources of Np nitrate *(97%)**
  - HM Process from enriched uranium (EU)
    - Approx. 3-4 kg / month (23% of total)*
    - Low plutonium contamination
  - Frames – dissolving irradiated Mk-53 targets
    - Approx. 8-10 kg / month (74% of total)*
    - Significant plutonium contamination

** ESH-HPT-96-117*

Pu contamination from HB Line

Report #	NpO2 (kg)	Minimum Pu wt%	Average Pu wt%	Maximum Pu wt%	# Billets made (235F)	# Tubes Extruded (321M)	SRDB #
DPSP-74-1-1	21.80	<0.05	0.16	0.60	5	12	72893
DPSP-74-1-2	4.84	0.18	0.36	0.53	7	12	72894
DPSP-74-1-3	12.65	0.02	0.18	0.42	5	0	72895
DPSP-74-1-4	5.25	0.01	0.03	0.06	4	14	72896
DPSP-74-1-5	2.25	0.25	0.28	0.32	0	0	72897

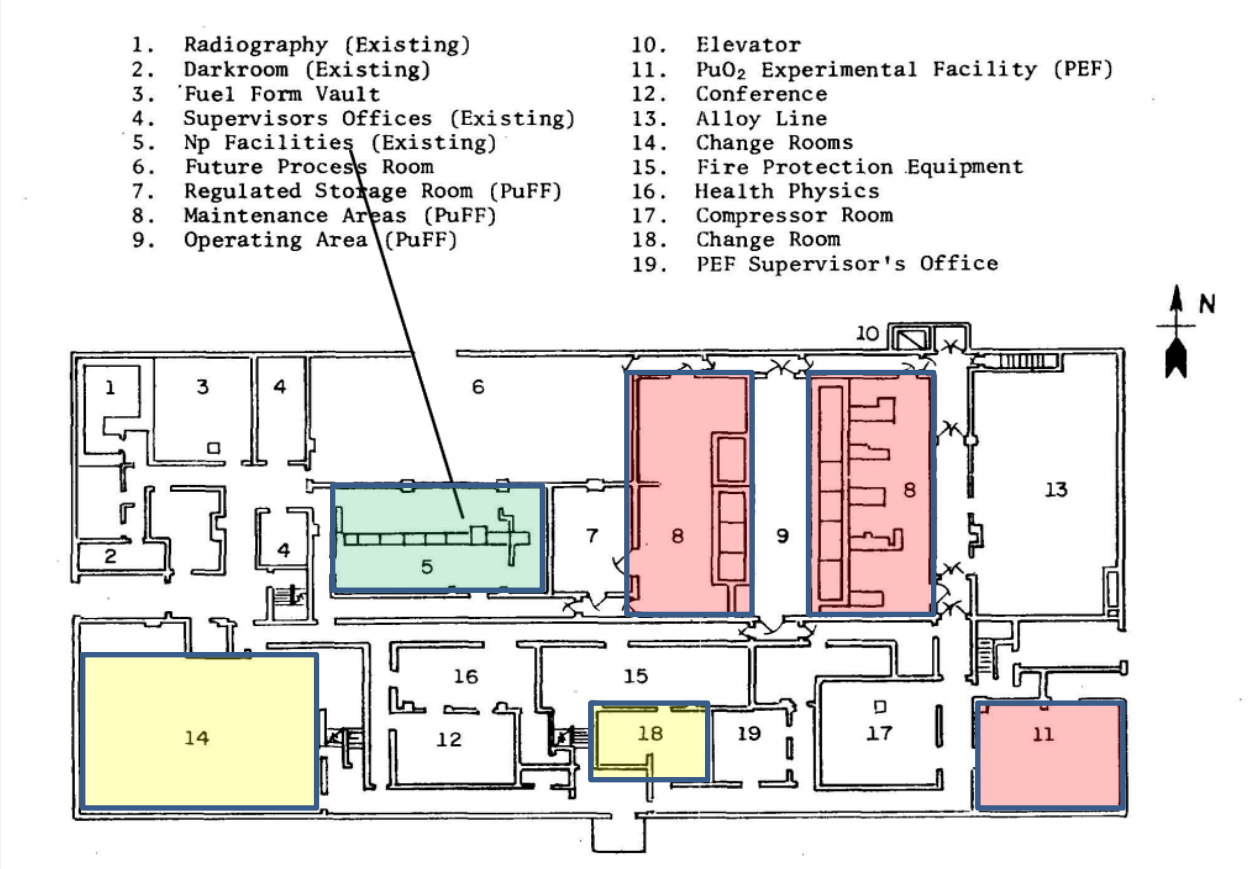
Why is Pu contamination important?

- **Specific Activity**
  (alpha activity)
  - **Pu-238 = 17.1 Ci/g**
  - **Np-237 = 0.00069 Ci/g**

Np wt%	Pu wt%	Pu : Np alpha ratio
99.5	0.5	125 : 1
99.9	0.1	25 : 1
99.95	0.05	12 : 1
99.99	0.01	2.5 : 1
99.995	0.005	1.2 : 1
99.999	0.001	0.25 : 1

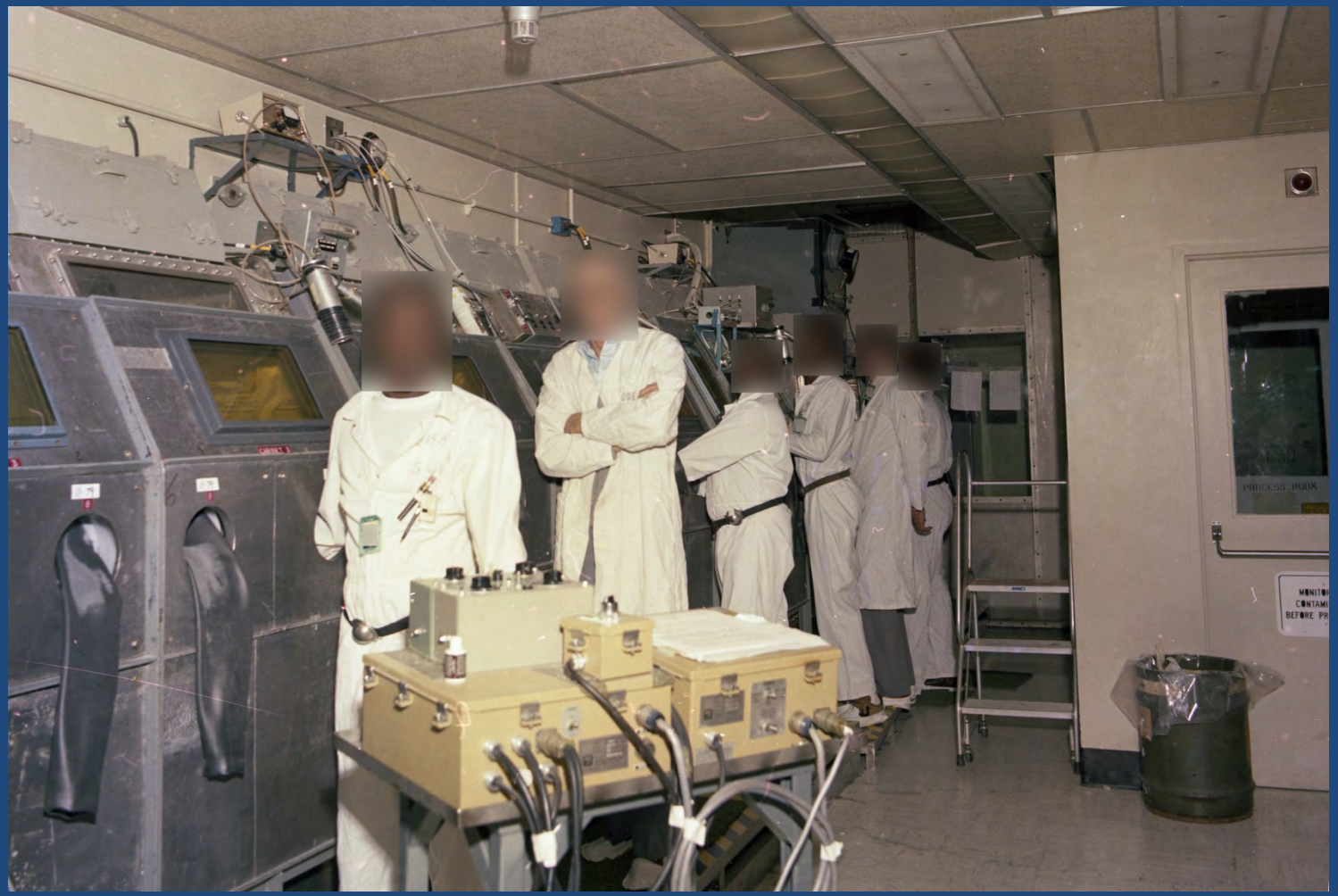
- **NpO_2 - Plutonium is the main hazard**
- **Requires ultra pure Np for it to dominate exposure**

Neptunium Billet Fabrication 235F



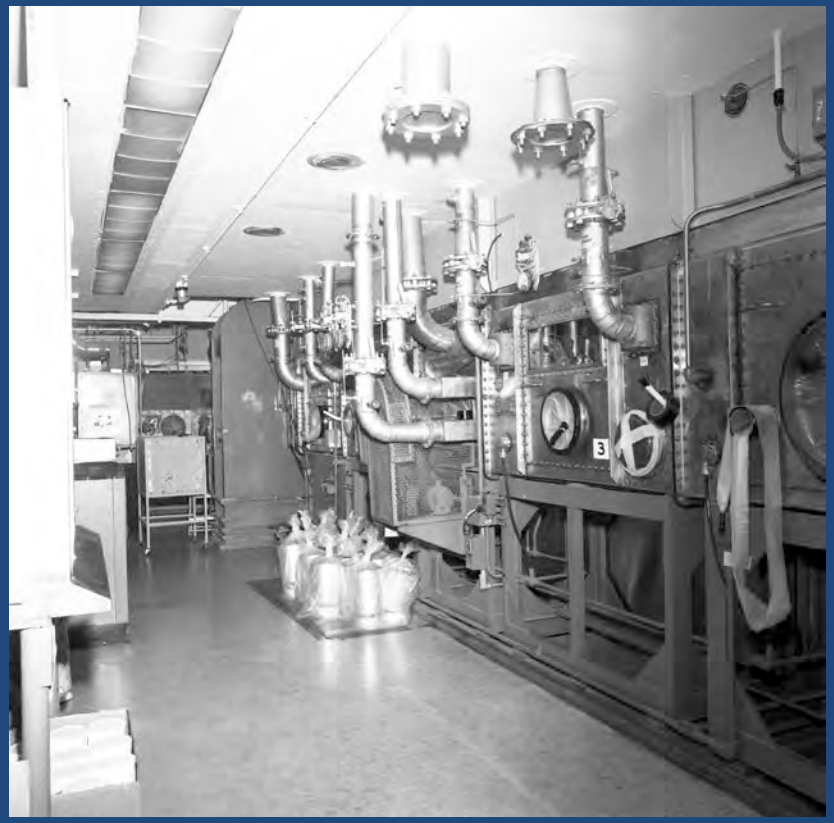
DPSTSA – 200-5

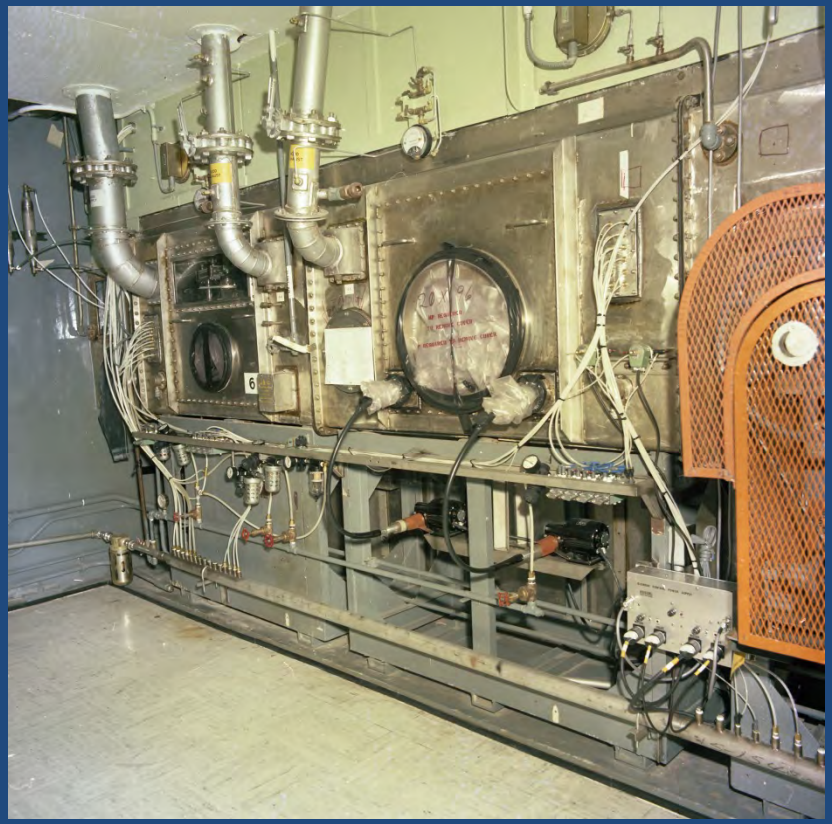
Neptunium Billet Glovebox Line



DPSPF 30200-6 (1980)

Neptunium Billet Glovebox Line





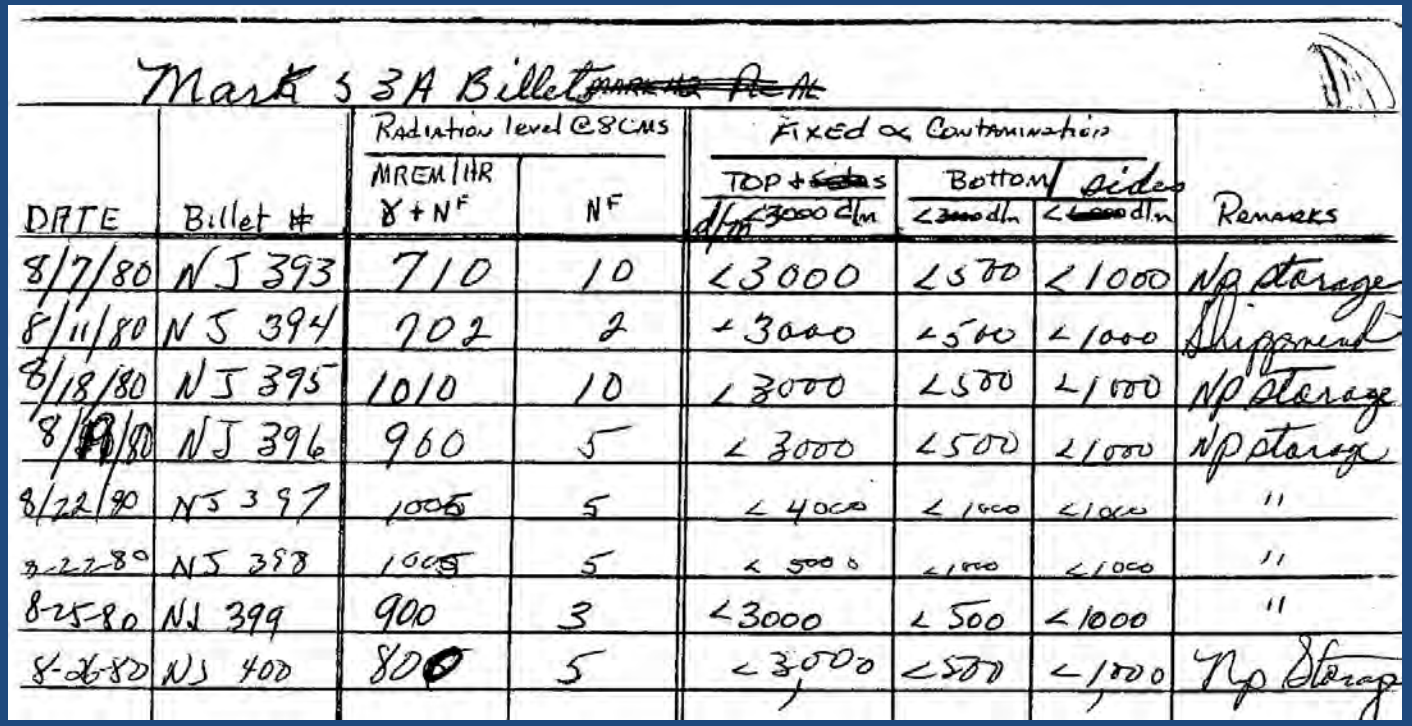
Maintenance side of glovebox line

235-F Summary / Observations

- Relatively small glovebox line
  - (10s of workers not 100s)
- Regulated radiation area
  - Supervisors – White Lab coat shoe covers
  - Operators – White regulated clothing and neutron dosimeters
- Shadow shields due to high gamma dose rate
- Billets are bagged for transfer to 321M

Radiological Controls - 235F

- Neptunium billets surveyed before transfer
  - High gamma dose rate
  - Neutron component is about 1%



Mark 53A Billets

DATE	Billet #	Radiation level @8CMS MREM/HR γ+NF	NF	Fixed & Contamination Top dpm/3000 dpm	Bottom dpm/500 dpm	Sides dpm/1000 dpm	Remarks
8/7/80	NJ 393	710	10	<3000	<500	<1000	Np storage
8/11/80	NJ 394	702	2	<3000	<500	<1000	Shipment
8/18/80	NJ 395	1010	10	<3000	<500	<1000	Np storage
8/19/80	NJ 396	960	5	<3000	<500	<1000	Np storage
8/22/80	NJ 397	1005	5	<4000	<1000	<1000	"
8-22-80	NJ 398	1005	5	<5000	<1000	<1000	"
8-25-80	NJ 399	900	3	<3000	<500	<1000	"
8-26-80	NJ 400	800	5	<3,000	<500	<1,000	Np Storage

Radiological Controls - 235F

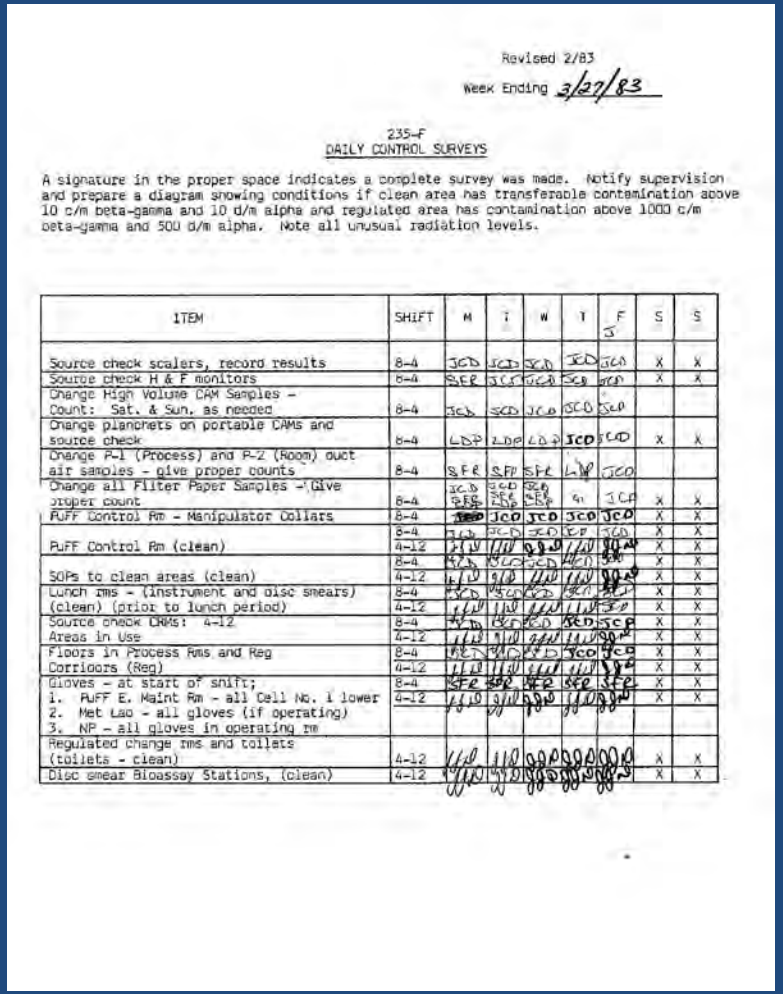
- Plutonium billets surveyed before transfer
  - Lower gamma dose rate
  - Neutron component is about 25%

MARK 42 Pu AL

DATE	Billet #	Radiation level @8CMS MREM/HR γ+N^F	Radiation level @8CMS MREM/HR NF	Fixed α Contamination Top + Sides <1000 dpm	Fixed α Contamination Bottom <3000 dpm	Fixed α Contamination Bottom <6000 dpm	Remarks
4-16-80	6063	120	20	✓	✓		shipped to 3-700
4-16-80	3060	140	20	✓	✓		" "
4-16-80	3063	160	30	—	—	—	vault only
4-17-80	3064	180	50	—	—	—	vault only
4-17-80	3065	165	15	—	—	—	Vault only
4/18/80	2064	120	20	—	—	—	vault only
4/18/80	6075	115	15	—	—	—	vault only
4/20/80	3066	140	40	—	—	—	vault only
4/23/80 PM	3066	140	40	—	—	—	Shipped

Radiological Controls - 235F

- Engineered Controls
  - Gloveboxes
- Workplace Radiation monitoring
  - Daily control surveys
  - Fixed Air Samples
  - Continuous Air Monitors (CAMs)
- Personnel Protective Equipment
  - Anti-contamination clothing



Revised 2/83

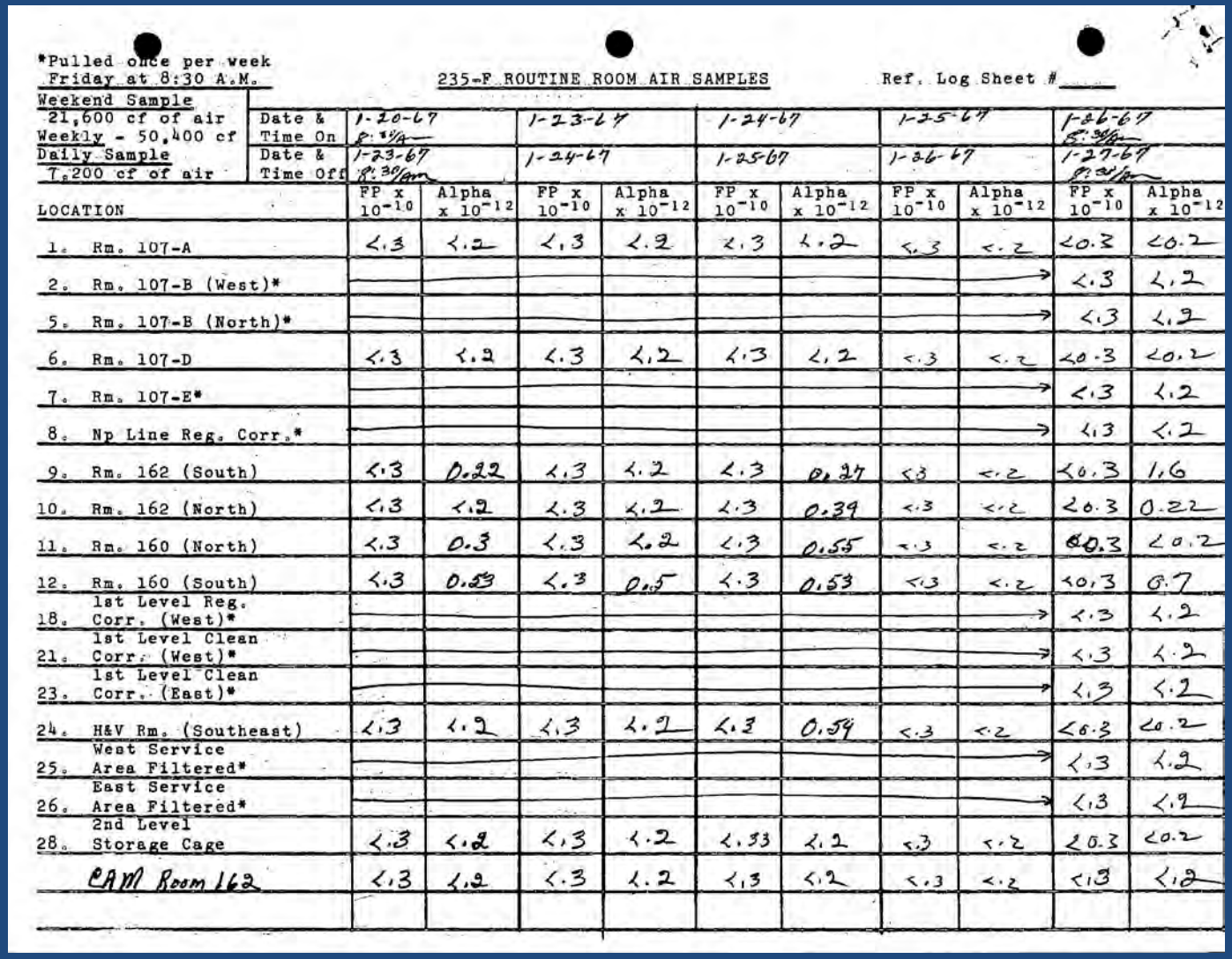
Week Ending 3/27/83

235-F
DAILY CONTROL SURVEYS

A signature in the proper space indicates a complete survey was made. Notify supervision and prepare a diagram showing conditions if clean area has transferable contamination above 10 c/m beta-gamma and 10 d/m alpha and regulated area has contamination above 1000 c/m beta-gamma and 500 d/m alpha. Note all unusual radiation levels.

ITEM	SHIFT	M	T	W	T	F	S	S
Source check scalers, record results	8-4	JCD	JCD	JCD	JCD	JCD	X	X
Source check H & F monitors	8-4	SFP	JCD	JCD	JCD	JCD	X	X
Change High Volume CAM Samples - Count: Sat. & Sun. as needed	8-4	JCD	JCD	JCD	JCD	JCD		
Change planchets on portable CAMs and source check	8-4	LDP	LDP	LDP	JCD	JCD	X	X
Change P-1 (Process) and P-2 (Room) duct air samples - give proper counts	8-4	SFP	SFP	SFP	LDP	JCD		
Change all Filter Paper Samples - Give proper count	8-4	JCD SFP	JCD SFP LDP	JCD SFP LDP	JCD	JCD	X	X
PUFF Control Rm - Manipulator Collars	8-4	JCD	JCD	JCD	JCD	JCD	X	X
PUFF Control Rm (clean)	8-4	JCD	JCD	JCD	JCD	JCD	X	X
	4-12						X	X
SOPs to clean areas (clean)	8-4	JCD	JCD	JCD	JCD	JCD	X	X
	4-12						X	X
Lunch rms - (instrument and disc smears) (clean) (prior to lunch period)	8-4	JCD	JCD	JCD	JCD	JCD	X	X
	4-12						X	X
Source check CAMs: 4-12 Areas in Use	8-4	JCD	JCD	JCD	JCD	JCD	X	X
	4-12						X	X
Floors in Process Rms and Reg Corridors (Reg)	8-4	JCD	JCD	JCD	JCD	JCD	X	X
	4-12						X	X
Gloves - at start of shift; 1. PUFF E. Maint Rm - all Cell No. 1 lower 2. Met Lab - all gloves (if operating) 3. NP - all gloves in operating rm	8-4	SFP	SFP	SFP	SFP	SFP	X	X
	4-12						X	X
Regulated change rms and toilets (toilets - clean)	4-12						X	X
Disc smear Bioassay Stations, (clean)	4-12						X	X

235F Routine Air Monitoring



*Pulled once per week Friday at 8:30 A.M.

235-F ROUTINE ROOM AIR SAMPLES

Ref. Log Sheet #____

Weekend Sample 21,600 cf of air
Weekly - 50,400 cf
Daily Sample 7,200 cf of air

LOCATION	Date & Time On / Date & Time Off	1-20-67 8:15 A / 1-23-67 8:30 AM		1-23-67 / 1-24-67		1-24-67 / 1-25-67		1-25-67 / 1-26-67		1-26-67 8:30 AM / 1-27-67 8:30 AM	
		FP x 10^{-10}	Alpha x 10^{-12}	FP x 10^{-10}	Alpha x 10^{-12}	FP x 10^{-10}	Alpha x 10^{-12}	FP x 10^{-10}	Alpha x 10^{-12}	FP x 10^{-10}	Alpha x 10^{-12}
1. Rm. 107-A		<1.3	<1.2	<1.3	<1.2	<1.3	<1.2	<.3	<.2	<0.3	<0.2
2. Rm. 107-B (West)*									→	<1.3	<1.2
5. Rm. 107-B (North)*									→	<1.3	<1.2
6. Rm. 107-D		<1.3	<1.2	<1.3	<1.2	<1.3	<1.2	<.3	<.2	<0.3	<0.2
7. Rm. 107-E*									→	<1.3	<1.2
8. Np Line Reg. Corr.*									→	<1.3	<1.2
9. Rm. 162 (South)		<1.3	0.22	<1.3	<1.2	<1.3	0.27	<3	<.2	<0.3	1.6
10. Rm. 162 (North)		<1.3	<1.2	<1.3	<1.2	<1.3	0.39	<.3	<.2	<0.3	0.22
11. Rm. 160 (North)		<1.3	0.3	<1.3	<0.2	<1.3	0.55	<.3	<.2	<0.3	<0.2
12. Rm. 160 (South)		<1.3	0.53	<1.3	0.5	<1.3	0.53	<.3	<.2	<0.3	0.7
18. 1st Level Reg. Corr. (West)*									→	<1.3	<1.2
21. 1st Level Clean Corr. (West)*									→	<1.3	<1.2
23. 1st Level Clean Corr. (East)*									→	<1.3	<1.2
24. H&V Rm. (Southeast)		<1.3	<1.2	<1.3	<1.2	<1.3	0.54	<.3	<.2	<0.3	<0.2
25. West Service Area Filtered*									→	<1.3	<1.2
26. East Service Area Filtered*									→	<1.3	<1.2
28. 2nd Level Storage Cage		<1.3	<1.2	<1.3	<1.2	<1.33	<1.2	<.3	<.2	<0.3	<0.2
CAM Room 162		<1.3	<1.2	<1.3	1.2	<1.3	<1.2	<.3	<.2	<1.3	<1.2

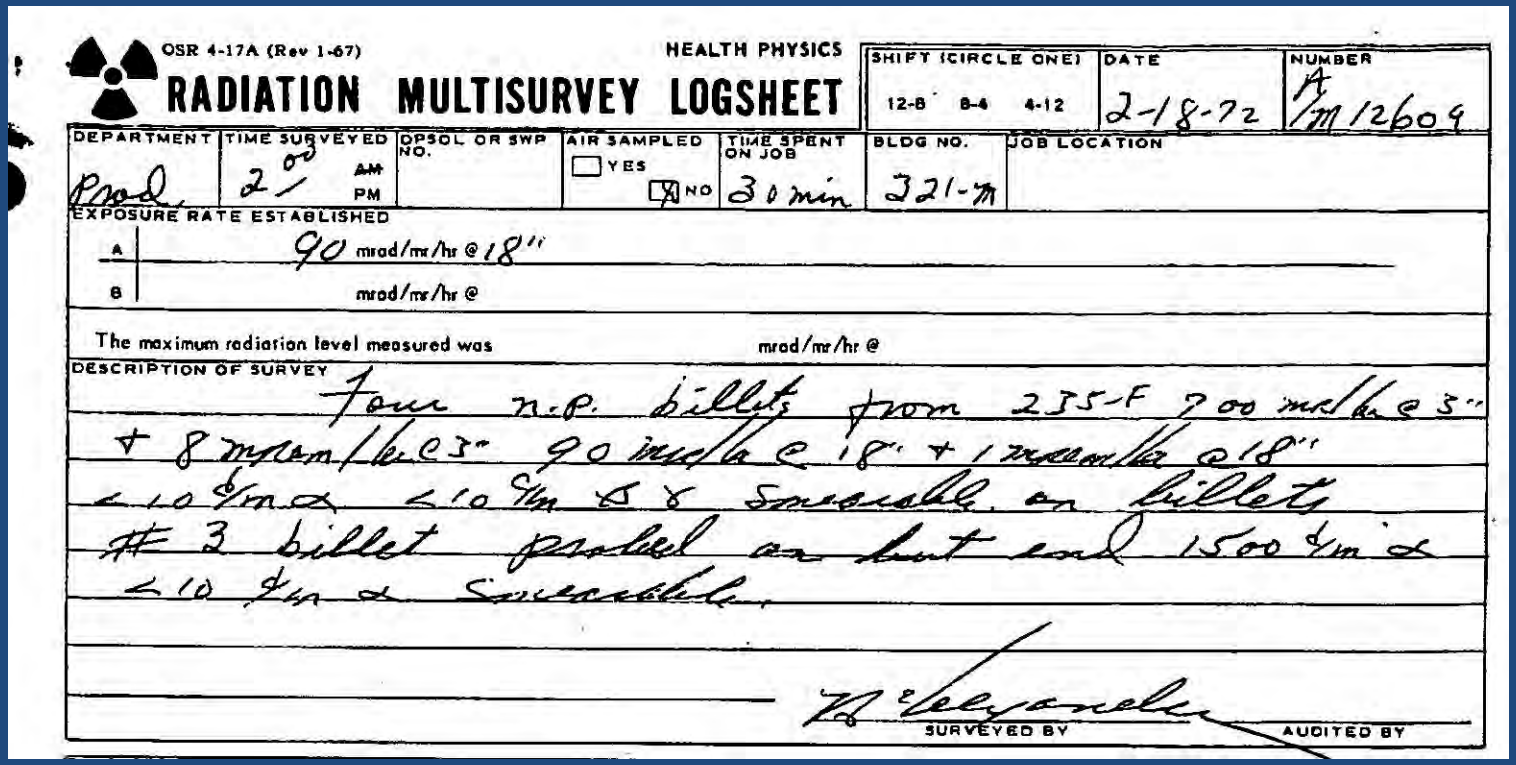
235-F Personnel Monitoring

- **Dosimeters**
  - Must wear dosimeter in regulated areas
    - Gamma dose rate was significant
    - Interviews indicate workforce swap-out
    - Operators were required to wear neutron dosimeters
- **Bioassay (DPSOL 193-302 Rev 8, 1978)**
  - 235-F workers bioassay category C and W
    - C = 2 plutonium samples per year
    - W = 1 neptunium sample per year

321M Np Billet Extrusion

- **Billet Extrusion Process**
  1. Bagged Billets are received
  2. Billets are surveyed
  3. Billets are helium leak checked
  4. Billets are outgassed
  5. Billets are preheated
  6. Billets extruded into long thin tubes
  7. Tubes are surveyed for shipment to reactors

321M Np Billet Survey - Example



OSR 4-17A (Rev 1-67)

HEALTH PHYSICS

RADIATION MULTISURVEY LOGSHEET

SHIFT (CIRCLE ONE)	DATE	NUMBER
12-8 8-4 4-12	2-18-72	M 12609

DEPARTMENT	TIME SURVEYED	OPSOL OR SWP NO.	AIR SAMPLED	TIME SPENT ON JOB	BLDG NO.	JOB LOCATION
Prod.	2 00 AM PM		☐ YES ☒ NO	30 min	321-M	

EXPOSURE RATE ESTABLISHED

A 90 mrad/mr/hr @ 18"

B mrad/mr/hr @

The maximum radiation level measured was mrad/mr/hr @

DESCRIPTION OF SURVEY

four n.p. billets from 235-F 700 mr/hr @ 3" + 8 mrem/hr @ 3" 90 mr/hr @ 18" + 1 mrem/hr @ 18" < 10 d/m α < 10 d/m β γ smearable on billets # 3 billet packed on hot end 1500 d/m α < 10 d/m α smearable.

W. E. Reynolds

SURVEYED BY

AUDITED BY

321M Np Billet Extrusion

A composite billet of uranium-aluminum alloy encased in aluminum enters extrusion press at the left and emerges at far right.

Bebbington (1990) History of DuPont at the Savannah River Plant

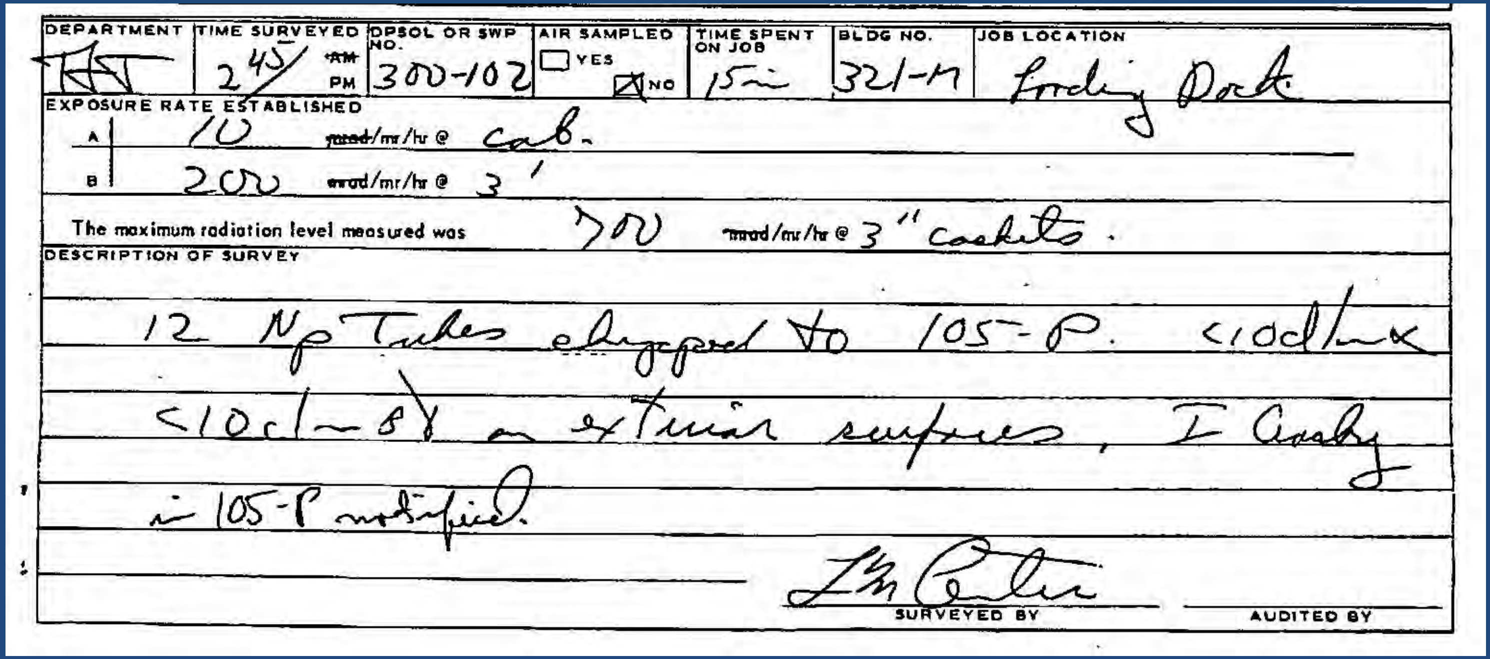
321M Np Billet Extrusion

Billet being forced into extrusion die; flames are lubricant ignited by the hot die.

Fuel tube emerging from die.

Bebbington (1990) History of DuPont at the Savannah River Plant

321M Np Tube Survey - Example



DEPARTMENT	TIME SURVEYED	OPSOL OR SWP NO.	AIR SAMPLED	TIME SPENT ON JOB	BLDG NO.	JOB LOCATION
HT	2:45 ~~AM~~ PM	300-102	☐ YES ☒ NO	15 min	321-M	Loading Dock

EXPOSURE RATE ESTABLISHED

A | 10 ~~mrad~~/mr/hr @ cab.

B | 200 ~~mrad~~/mr/hr @ 3'

The maximum radiation level measured was 700 ~~mrad~~/mr/hr @ 3" caskets.

DESCRIPTION OF SURVEY

12 Np Tubes shipped to 105-P. <100 d/m α

<100 c/m β γ on exterior surfaces, I Analy

in 105-P notified.

[illegible signature]
SURVEYED BY

AUDITED BY

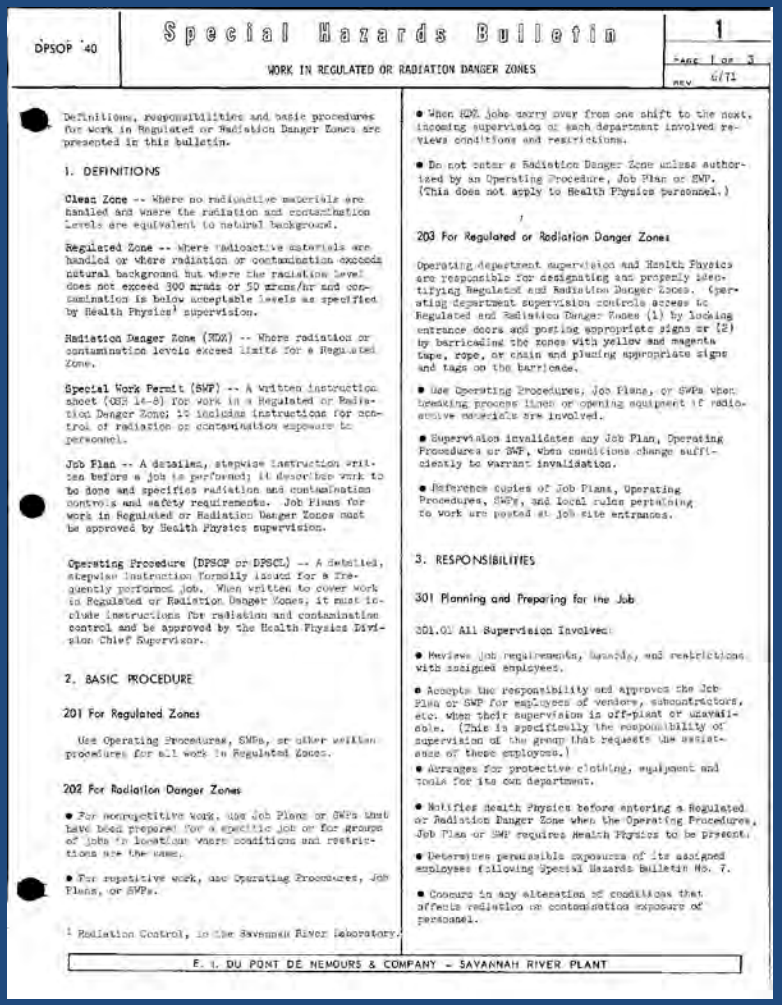
Radiological Controls 1972-1990

- Since 1956 Special Hazards Bulletins and DPSOP-40 Savannah River Plant Radiation and Contamination Control covered:

1. Work in Regulated Areas
2. Investigating radiation and contamination incidents
3. Protective clothing
4. Injury in regulated areas
5. Disposal of contaminated waste
6. Fires in regulated areas
7. Radiation exposure control

Work in Regulated Areas

- Definitions
- Basic Procedure
- Responsibilities



DPSOP 40

Special Hazards Bulletin

1

WORK IN REGULATED OR RADIATION DANGER ZONES

PAGE 1 OF 3

REV 6/71

Definitions, responsibilities and basic procedures for work in Regulated or Radiation Danger Zones are presented in this bulletin.

1. DEFINITIONS

Clean Zone -- Where no radioactive materials are handled and where the radiation and contamination levels are equivalent to natural background.

Regulated Zone -- Where radioactive materials are handled or where radiation or contamination exceeds natural background but where the radiation level does not exceed 300 mrads or 50 mrem/hr and contamination is below acceptable levels as specified by Health Physics[1] supervision.

Radiation Danger Zone (RDZ) -- Where radiation or contamination levels exceed limits for a Regulated Zone.

Special Work Permit (SWP) -- A written instruction sheet (OHS 14-8) for work in a Regulated or Radiation Danger Zone; it includes instructions for control of radiation or contamination exposure to personnel.

Job Plan -- A detailed, stepwise instruction written before a job is performed; it describes work to be done and specifies radiation and contamination controls and safety requirements. Job Plans for work in Regulated or Radiation Danger Zones must be approved by Health Physics supervision.

Operating Procedure (DPSOP or DPSCL) -- A detailed, stepwise instruction formally issued for a frequently performed job. When written to cover work in Regulated or Radiation Danger Zones, it must include instructions for radiation and contamination control and be approved by the Health Physics Division Chief Supervisor.

2. BASIC PROCEDURE

201 For Regulated Zones

Use Operating Procedures, SWPs, or other written procedures for all work in Regulated Zones.

202 For Radiation Danger Zones

- For nonrepetitive work, use Job Plans or SWPs that have been prepared for a specific job or for groups of jobs in location where conditions and restrictions are the same.
- For repetitive work, use Operating Procedures, Job Plans, or SWPs.

[1] Radiation Control, in the Savannah River Laboratory.

- When RDZ jobs carry over from one shift to the next, incoming supervision of each department involved reviews conditions and restrictions.
- Do not enter a Radiation Danger Zone unless authorized by an Operating Procedure, Job Plan or SWP. (This does not apply to Health Physics personnel.)

203 For Regulated or Radiation Danger Zones

Operating department supervision and Health Physics are responsible for designating and properly identifying Regulated and Radiation Danger Zones. Operating department supervision controls access to Regulated and Radiation Danger Zones (1) by locking entrance doors and posting appropriate signs or (2) by barricading the zones with yellow and magenta tape, rope, or chain and placing appropriate signs and tags on the barricade.

- Use Operating Procedures, Job Plans, or SWPs when breaking process lines or opening equipment if radioactive materials are involved.
- Supervision invalidates any Job Plan, Operating Procedures or SWP, when conditions change sufficiently to warrant invalidation.
- Reference copies of Job Plans, Operating Procedures, SWPs, and local rules pertaining to work are posted at job site entrances.

3. RESPONSIBILITIES

301 Planning and Preparing for the Job

301.01 All Supervision Involved:

- Reviews job requirements, hazards, and restrictions with assigned employees.
- Accepts the responsibility and approves the Job Plan or SWP for employees of vendors, subcontractors, etc. when their supervision is off-plant or unavailable. (This is specifically the responsibility of supervision of the group that requests the assistance of these employees.)
- Arranges for protective clothing, equipment and tools for its own department.
- Notifies Health Physics before entering a Regulated or Radiation Danger Zone when the Operating Procedures, Job Plan or SWP requires Health Physics to be present.
- Determines permissible exposures of its assigned employees following Special Hazards Bulletin No. 7.
- Concurs in any alteration of conditions that affects radiation or contamination exposure of personnel.

E. I. DU PONT DE NEMOURS & COMPANY - SAVANNAH RIVER PLANT

Special Hazards Bulletin #1, SRDB 86188, p. 163

Definitions and Basic Procedure

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Special Hazards Bulletin #1, SRDB 86188

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Special Hazards Bulletin #1, SRDB 86188

Basic Procedures & Responsibilities

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Special Hazards Bulletin #1, SRDB 86188

301.04 Health Physics:

- Reviews the Job Plan or SWP and specifies monitoring required and adds additional precautions, protective clothing, or equipment requirements.
- Determines exposure rates at the job site and apprises personnel of the rates and time limits.
- Recommends decontamination of job site and/or installation of additional shielding, if necessary, to reduce exposure or protective equipment requirements.

Special Hazards Bulletin #1, SRDB 86188

SHB #3 - Protective Clothing

DPSOP 40

Special Hazards Bulletin

3

PROTECTIVE CLOTHING

PAGE 1 OF 1

REV 6/72

Protective clothing is provided for use in Regulated or Radiation Danger Zones where real or potential contamination exists.

1. TYPES AND USES

▶ Protective clothing for Special Hazards use includes such items as coveralls, caps, shoe covers, rubber and cotton gloves, and laboratory coats.

▶ Two colors of protective clothing are used to minimize cross-contamination in the areas or laboratories, and to facilitate handling and decontamination in the laundry.

White -- to be worn in locations that may be contaminated by plutonium, fission products, or other artificial radioisotopes.

Brown -- to be worn in locations that may be contaminated by uranium.

2. RESPONSIBILITIES

201 Supervision of the Operating Department or Facility

• Ensures that adequate supplies of the proper type of protective clothing are provided and worn in specified locations.

• Ensures that protective clothing is properly identified by area, building, or facility number so the laundry can identify and return the clothing to its proper place.

202 Supervision of the Laundry

• Sees that clothing is laundered in the proper equipment, according to the color of the clothing and type of contamination.

• Has laundered clothing meeting contamination control guides sorted, bagged, and returned to the same facility that sent it.

Special Hazards Bulletin #3, SRDB 86188, p. 166

DPSOP-40 Control Guides

RADIATION & CONTAM CONTROL
DPSOP 40
June 1971 Rev 36

DO NOT REMOVE
FROM SRP WITHOUT APPROVAL

I DEFINITIONS & CONTROL GUIDES
B Control Guides

1. External Radiation

See Special Hazards Bulletin 7, Radiation Exposure Control, in chapter V.

2. External Contamination

Skin and personal clothing must be free of contamination as monitored by the most sensitive appropriate instruments.

3. Internal Radiation

See Technical Standard DPSTS-RH-0.07, Personnel Monitoring.

4. Airborne Radioactivity Concentrations

Radioactivity Concentration Guides for unidentified isotopes and some specific isotopes in air are listed below. Respiratory protective equipment of the type indicated is required when concentrations exceed the guide values.

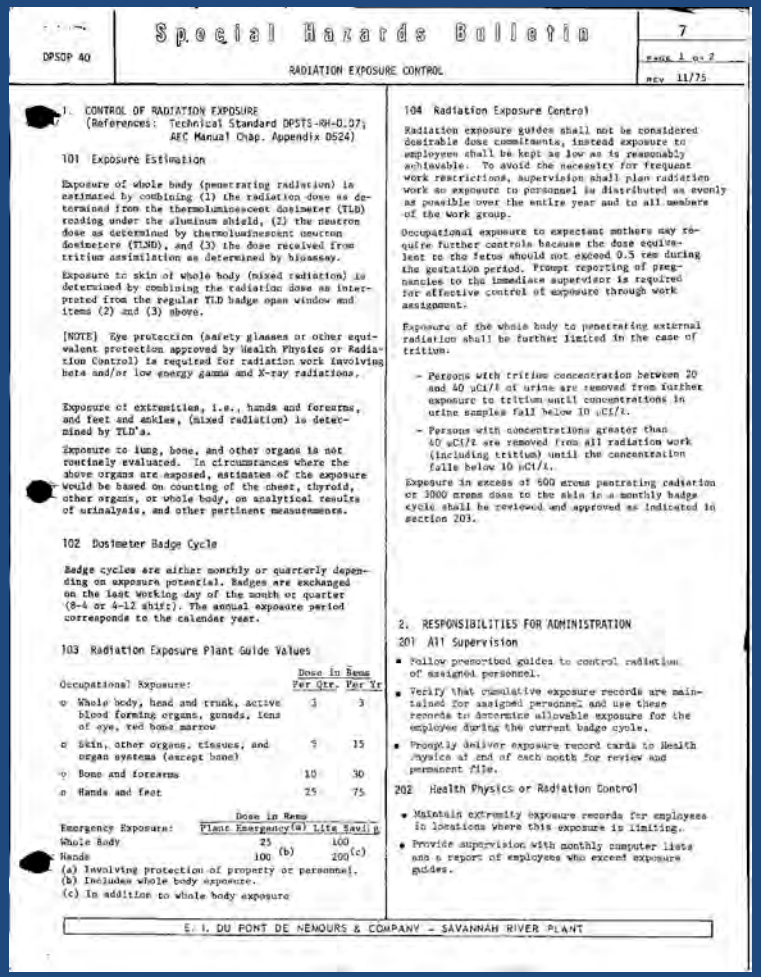
Equipment Type	Concentration,[a] μCi/cc Filter	Air-Supplied
Unidentified		
Alpha	2×10^{-12}	2×10^{-10}
Beta-gamma	1×10^{-9}	1×10^{-7}
Uranium		
Natural	6×10^{-11}	6×10^{-9}
Enriched	1×10^{-10}	1×10^{-8}
Americium	6×10^{-12}	6×10^{-10}
Neptunium	4×10^{-12}	4×10^{-10}
Curium[b]	2×10^{-12}	2×10^{-10}
Californium	2×10^{-12}	2×10^{-10}
Plutonium	2×10^{-12}	2×10^{-10}
Thorium	2×10^{-12}	2×10^{-10}
Tritium	-	5×10^{-6}
Iodine	-	9×10^{-9}
Mixed fission product[c]	6×10^{-9}	6×10^{-7}

a Based on 40-hour week.

b The Radioactivity Concentration Guides for the various isotopes of curium produced during the transplutonium program at SRP ranged from 9×10^{-12} for ^{244}Cm to 6×10^{-13} for ^{248}Cm. Because of the low yield of ^{248}Cm (0.05 weight percent, mass abundance), the RCG for unidentified alpha isotopes will be followed for all isotopes of curium produced by this method.

c Extensive test in reactor and separations areas indicated that, for mixed isotopes encountered in those areas, this value is within recognized Radioactivity Concentration Guides for the specific isotopes involved.

Special Hazards Bulletin #7
Radiological Exposure Control



DPSOP 40

Special Hazards Bulletin 7

page 1 of 2

RADIATION EXPOSURE CONTROL rev 11/75

1. CONTROL OF RADIATION EXPOSURE
(References: Technical Standard DPSTS-RH-0.07; AEC Manual Chap. Appendix 0524)

101 Exposure Estimation

Exposure of whole body (penetrating radiation) is estimated by combining (1) the radiation dose as determined from the thermoluminescent dosimeter (TLD) reading under the aluminum shield, (2) the neutron dose as determined by thermoluminescent neutron dosimeters (TLND), and (3) the dose received from tritium assimilation as determined by bioassay.

Exposure to skin of whole body (mixed radiation) is determined by combining the radiation dose as interpreted from the regular TLD badge open window and items (2) and (3) above.

[NOTE] Eye protection (safety glasses or other equivalent protection approved by Health Physics or Radiation Control) is required for radiation work involving beta and/or low energy gamma and X-ray radiations.

Exposure of extremities, i.e., hands and forearms, and feet and ankles, (mixed radiation) is determined by TLD's.

Exposure to lung, bone, and other organs is not routinely evaluated. In circumstances where the above organs are exposed, estimates of the exposure would be based on counting of the chest, thyroid, other organs, or whole body, on analytical results of urinalysis, and other pertinent measurements.

102 Dosimeter Badge Cycle

Badge cycles are either monthly or quarterly depending on exposure potential. Badges are exchanged on the last working day of the month or quarter (8-4 or 4-12 shift). The annual exposure period corresponds to the calendar year.

103 Radiation Exposure Plant Guide Values

Occupational Exposure:	Dose in Rems Per Qtr.	Per Yr
o Whole body, head and trunk, active blood forming organs, gonads, lens of eye, red bone marrow	3	3
o Skin, other organs, tissues, and organ systems (except bone)	5	15
o Bone and forearms	10	30
o Hands and feet	25	75

Emergency Exposure:	Dose in Rems Plant Emergency(a)	Life Saving
Whole Body	25	100
Hands	100 (b)	200 (c)

(a) Involving protection of property or personnel.
(b) Includes whole body exposure.
(c) In addition to whole body exposure

104 Radiation Exposure Control

Radiation exposure guides shall not be considered desirable dose commitments, instead exposure to employees shall be kept as low as is reasonably achievable. To avoid the necessity for frequent work restrictions, supervision shall plan radiation work so exposure to personnel is distributed as evenly as possible over the entire year and to all members of the work group.

Occupational exposure to expectant mothers may require further controls because the dose equivalent to the fetus should not exceed 0.5 rem during the gestation period. Prompt reporting of pregnancies to the immediate supervisor is required for effective control of exposure through work assignment.

Exposure of the whole body to penetrating external radiation shall be further limited in the case of tritium:

- Persons with tritium concentration between 20 and 40 μCi/ℓ of urine are removed from further exposure to tritium until concentrations in urine samples fall below 10 μCi/ℓ.
- Persons with concentrations greater than 40 μCi/ℓ are removed from all radiation work (including tritium) until the concentration falls below 10 μCi/ℓ.

Exposure in excess of 600 mrems penetrating radiation or 3000 mrems dose to the skin in a monthly badge cycle shall be reviewed and approved as indicated in section 203.

2. RESPONSIBILITIES FOR ADMINISTRATION

201 All Supervision

- Follow prescribed guides to control radiation of assigned personnel.
- Verify that cumulative exposure records are maintained for assigned personnel and use these records to determine allowable exposure for the employee during the current badge cycle.
- Promptly deliver exposure record cards to Health Physics at end of each month for review and permanent file.

202 Health Physics or Radiation Control

- Maintain extremity exposure records for employees in locations where this exposure is limiting.
- Provide supervision with monthly computer lists and a report of employees who exceed exposure guides.

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103 Radiation Exposure Plant Guide Values

Occupational Exposure:	Dose in Rems Per Qtr.	Per Yr
o Whole body, head and trunk, active blood forming organs, gonads, lens of eye, red bone marrow	3	3
o Skin, other organs, tissues, and organ systems (except bone)	5	15
o Bone and forearms	10	30
o Hands and feet	25	75

203 Departure from Guides

Exceeding the exposure control guides as indicated in the last sentence of section 104 requires the following approvals:

SRP — Department Superintendent and Health Physics Section Chief Supervisor

SRL — Research Manager of Division involved and Radiological Sciences Division Research Manager

SRP Construction — Field Project Manager

Exceeding the radiation exposure annual guide values (section 103), but within the permissible exposure levels as set forth in Technical Standard RH-0.07, requires approval of either:
Plant Manager (SRP),
Laboratory Director (SRL), or
Field Project Manager (SRP Construction)

Special Hazards Bulletin #7, SRDB 86188, p. 61

DPSTS-RH-0.07 – Personnel Monitoring

DPSTS-RH-0.07
Revised: 8/69
Copy

PERSONNEL MONITORING

A. APPLICABILITY

This standard applies to the control and measurement of external and internal radiation exposure to personnel at the Savannah River Plant (SRP) and the Savannah River Laboratory (SRL).

B. BASIS

The bases for this standard are operating experience, published guides in AEC Manual Chapters 0524 and 0230, and recommendations of the Federal Radiation Council (FRC), the National Committee on Radiation Protection (NCRP), and the International Commission on Radiological Protection (ICRP).

C. STANDARD

Radiation exposure of the critical organs, whole body, skin of the whole body, and extremities of personnel in SRP and SRL shall be controlled to prevent exceeding the Radiation Protection Guides established in AEC Manual Chapter 0524 or in absence of direct guidance from the AEC, the most restrictive guide of the FRC, NCRP, and ICRP. In addition, other applicable guides established for the protection of personnel are the following:

1. Special Work Permits, DPSOLs, or equivalent procedures shall be provided to cover all work with radioactive materials or where radioactive materials are handled. Time limits, protective clothing and radiation monitoring equipment requirements, respiratory protection, special precautions, and instructions shall be defined by the procedures.

2. All personnel entering areas in which they will receive a sustained radiation exposure at a rate >1 mrem/hr, or intermittent exposures that will accumulate to >25 mrems in one week, shall be required to wear either a film badge or a thermoluminescent dosimeter (TLD) badge somewhere between the waist and neck line. The film or TLD shall be processed at a frequency commensurate with expected radiation exposure of each individual, good health physics practice, and the limitations imposed by fading or fogging of the personnel monitoring device used. Permanent records of an individual's exposure data will be made in accordance with guides established in AEC Manual Chapter 0230 Appendix.

DPSTS-RH-0.07
Revised: 8/69

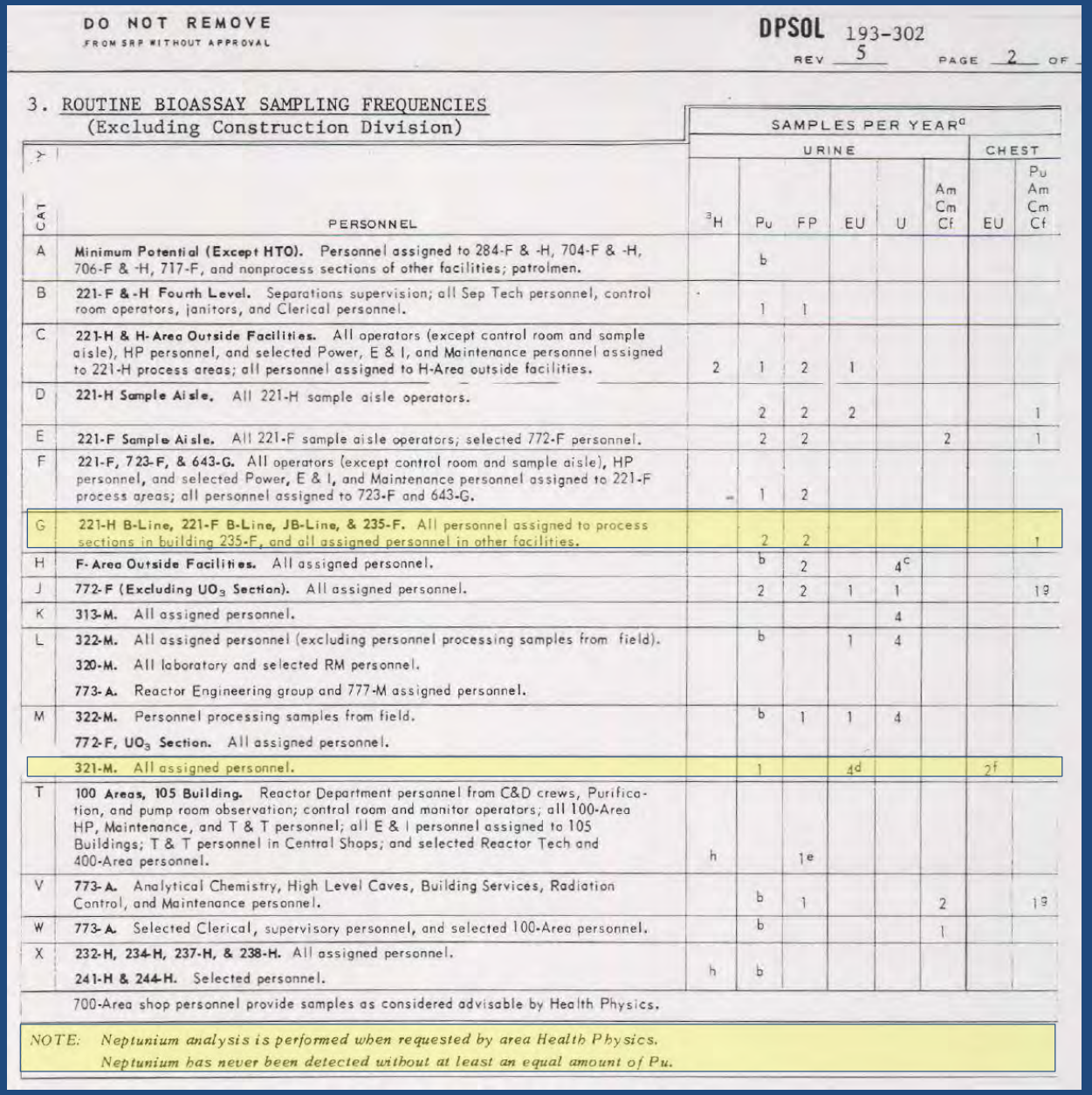
5. In order to provide a record of potential radiation exposures of personnel who do not wear film or TLD badges but who could be exposed intermittently to low levels of radiation during their work, Health Physics* shall establish monitoring stations so that radiation exposures of these people can be estimated. Dosimeters from these stations shall be processed and the data permanently recorded at least once a month.

6. Personnel who can be exposed to internal contamination by radioactive materials (other than normal background) in the normal course of their work shall submit voidings to be analyzed for the suspected contaminants. The frequency for submission of voidings shall be established by the Health Physics Division*, taking into account such factors as the likelihood of exposure, sensitivity of detection methods, and the maximum permissible body burdens listed by the AEC, FRC, NCRP, and ICRP.

* Radiation Control in SRL.

Bioassay Control

- DPSOL 193-302
  - Rev. 5 (1971)



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DPSOL 193-302
REV 5 PAGE 2 OF

3. ROUTINE BIOASSAY SAMPLING FREQUENCIES
(Excluding Construction Division)

CAT	PERSONNEL	SAMPLES PER YEAR[a] URINE ^{3}H	Pu	FP	EU	U	Am Cm Cf	CHEST EU	Pu Am Cm Cf
A	**Minimum Potential (Except HTO).** Personnel assigned to 284-F & -H, 704-F & -H, 706-F & -H, 717-F, and nonprocess sections of other facilities; patrolmen.		b						
B	**221-F & -H Fourth Level.** Separations supervision; all Sep Tech personnel, control room operators, janitors, and Clerical personnel.		1	1					
C	**221-H & H-Area Outside Facilities.** All operators (except control room and sample aisle), HP personnel, and selected Power, E & I, and Maintenance personnel assigned to 221-H process areas; all personnel assigned to H-Area outside facilities.	2	1	2	1				
D	**221-H Sample Aisle.** All 221-H sample aisle operators.		2	2	2				1
E	**221-F Sample Aisle.** All 221-F sample aisle operators; selected 772-F personnel.		2	2			2		1
F	**221-F, 723-F, & 643-G.** All operators (except control room and sample aisle), HP personnel, and selected Power, E & I, and Maintenance personnel assigned to 221-F process areas; all personnel assigned to 723-F and 643-G.		1	2					
G	**221-H B-Line, 221-F B-Line, JB-Line, & 235-F.** All personnel assigned to process sections in building 235-F, and all assigned personnel in other facilities.		2	2					1
H	**F-Area Outside Facilities.** All assigned personnel.		b	2		4[c]			
J	**772-F (Excluding UO_3 Section).** All assigned personnel.		2	2	1	1			1[g]
K	**313-M.** All assigned personnel.					4			
L	**322-M.** All assigned personnel (excluding personnel processing samples from field). **320-M.** All laboratory and selected RM personnel. **773-A.** Reactor Engineering group and 777-M assigned personnel.		b		1	4			
M	**322-M.** Personnel processing samples from field. **772-F, UO_3 Section.** All assigned personnel.		b	1	1	4			
	321-M. All assigned personnel.		1		4[d]			2[f]	
T	**100 Areas, 105 Building.** Reactor Department personnel from C&D crews, Purification, and pump room observation; control room and monitor operators; all 100-Area HP, Maintenance, and T & T personnel; all E & I personnel assigned to 105 Buildings; T & T personnel in Central Shops; and selected Reactor Tech and 400-Area personnel.	h		1[e]					
V	**773-A.** Analytical Chemistry, High Level Caves, Building Services, Radiation Control, and Maintenance personnel.		b	1			2		1[g]
W	**773-A.** Selected Clerical, supervisory personnel, and selected 100-Area personnel.		b				1		
X	**232-H, 234-H, 237-H, & 238-H.** All assigned personnel. **241-H & 244-H.** Selected personnel.	h	b						
	700-Area shop personnel provide samples as considered advisable by Health Physics.								

NOTE: Neptunium analysis is performed when requested by area Health Physics. Neptunium has never been detected without at least an equal amount of Pu.

Bioassay Control - Construction

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DPSOL 193-302
REV 5 PAGE 3 OF 14

4. BIOASSAY SAMPLING FREQUENCIES — Construction Division

a. Routine Urine Samples

- Fission Products and/or Induced Activity — one sample per year and when terminating.
- Tritium — sample frequency is outlined in Radiation and Contamination Control DPSOP 40-1 or Construction Job Plans.
- Plutonium — one sample every 3 years and when terminating.
- Other Nuclides — as specified by area Health Physics in Construction Job Plans.

[NOTE] Construction Division Medical Department annually provides each employee with a sample bottle and label and instructs the employee to submit a one-liter urine sample. Samples are also obtained from new employees who worked in Radiation Zones at another installation where radioactive materials were handled. Personnel Monitoring will forward requests for resamples through Construction Medical.

b. Special Sampling (See Division B and Construction Division Safety Procedure 58)

c. Whole Body or Chest Counting

1) New employees, who worked in Radiation Zones at another installation where radioactive materials were handled, will be required to take a whole body and chest count. This count should preferably be made on the same day as the entry physical examination.

2) A whole body and/or chest count shall be made whenever an employee's bioassay samples (except tritium) indicate he has a confirmed uptake or when he has been involved in a contamination incident and a count is considered necessary by Health Physics supervision.

3) A count (chest or 40 cm arc) will be required when terminating for those employees who have had a previous whole body or chest count at SRP.

DPSOL 193-302 (Rev 5. 1971)

Bioassay Control Procedure Revision

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HEALTH PROTECTION DEPARTMENT
DPSOP Ref 193

DPSOL 193-302T
Revision 0
Approval Date 2/25/85
Page 1 of 18

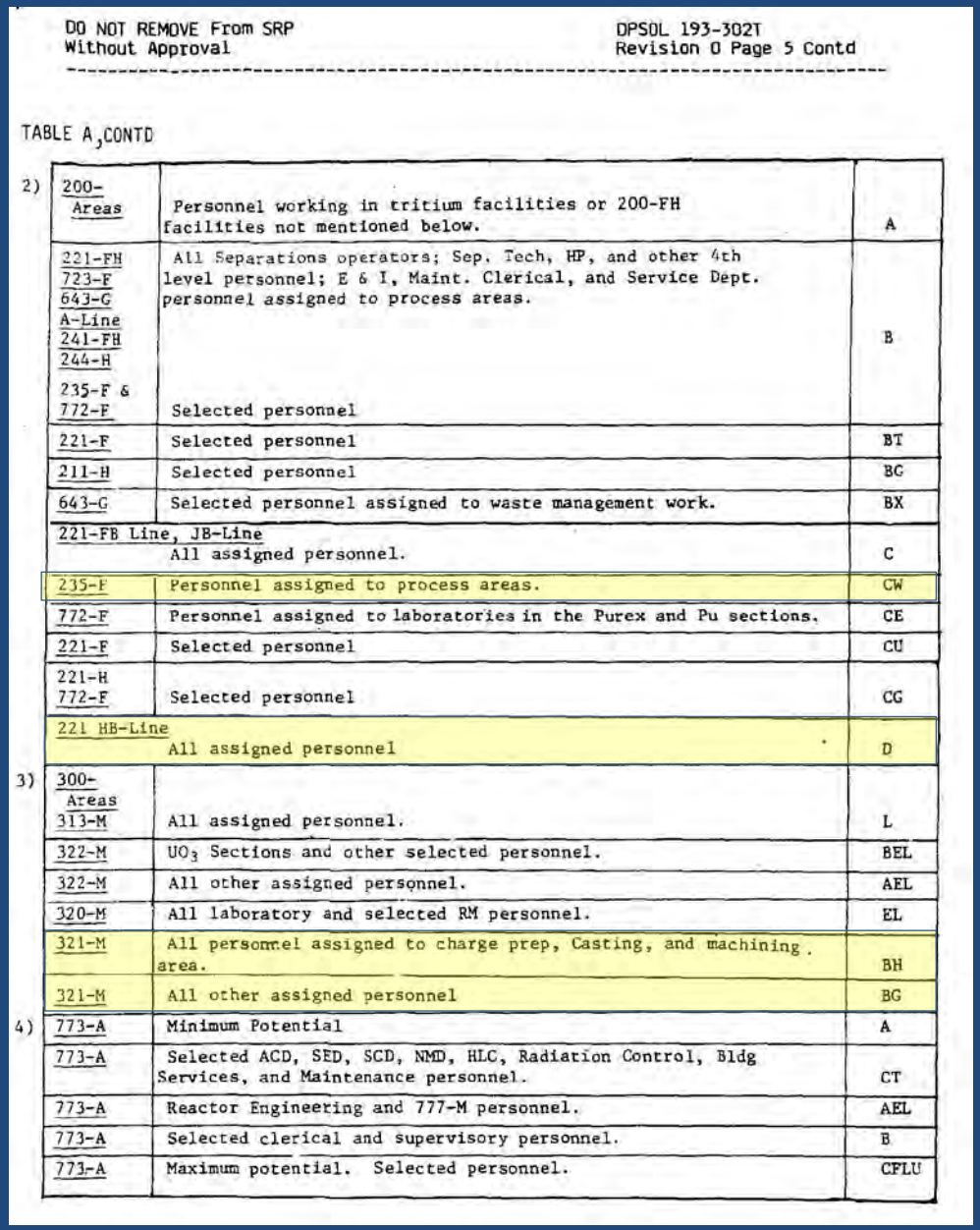
BIOASSAY CONTROL (TEMPORARY)

[NOTE: This DPSOL is a duplicate of DPSOL 193-302, Rev 8, approved 1/78 from the old manual. It is to be used until new bioassay procedures 193-211, -212, and -213 are issued.]

PURPOSE: To establish operating guides, bioassay sampling and in-vivo counting frequencies, and related administrative controls.

Bioassay Control

- DPSOL 193-302
  - Rev. 8 (1978)
- DPSOL 193-302T
  - Rev. 0 (1985)
- DPSOL 193-211
  - Rev. 0 (1989)



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DPSOL 193-302T
Revision 0 Page 5 Contd

TABLE A, CONTD

2)	200-Areas	Personnel working in tritium facilities or 200-FH facilities not mentioned below.	A
	221-FH 723-F 643-G A-Line 241-FH 244-H	All Separations operators; Sep. Tech, HP, and other 4th level personnel; E & I, Maint. Clerical, and Service Dept. personnel assigned to process areas.	B
	235-F & 772-F	Selected personnel	
	221-F	Selected personnel	BT
	211-H	Selected personnel	BG
	643-G	Selected personnel assigned to waste management work.	BX
	221-FB Line, JB-Line	All assigned personnel.	C
	235-F	Personnel assigned to process areas.	CW
	772-F	Personnel assigned to laboratories in the Purex and Pu sections.	CE
	221-F	Selected personnel	CU
	221-H 772-F	Selected personnel	CG
	221 HB-Line	All assigned personnel	D
3)	300-Areas 313-M	All assigned personnel.	L
	322-M	UO_3 Sections and other selected personnel.	BEL
	322-M	All other assigned personnel.	AEL
	320-M	All laboratory and selected RM personnel.	EL
	321-M	All personnel assigned to charge prep, Casting, and machining area.	BH
	321-M	All other assigned personnel	BG
4)	773-A	Minimum Potential	A
	773-A	Selected ACD, SED, SCD, NMD, HLC, Radiation Control, Bldg Services, and Maintenance personnel.	CT
	773-A	Reactor Engineering and 777-M personnel.	AEL
	773-A	Selected clerical and supervisory personnel.	B
	773-A	Maximum potential. Selected personnel.	CFLU

Bioassay Control

- DPSOL 193-302
  - Rev. 8 (1978)
- DPSOL 193-302T
  - Rev. 0 (1985)
- DPSOL 193-211
  - Rev. 0 (1989)

TABLE B

Nuclide	Description of Code Samples/year	Code
Plutonium	0.3	A
	1	B
	2	C
	4	D
Enriched Uranium	1	E
	2	F
	4	G
	12	H
Natural Uranium	1	J
	2	K
	4	L
	12	M
Fission Product Induced Activities	0	N
	1	P
	2	R
	4	S
Americium Curium and Californium	1	T
	2	U
	4	V
Neptunium	1	W
Strontium	1	X
	2	Y
	4	Z

DPSOL 193-302T (Rev 0 1985)

Bioassay Control - Construction

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DPSOL 193-302T
Revision 0 Page 7 Contd

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2. Construction Division

2.1 Routine Urine Samples

- o *Fission Products and/or Induced Activity*. One sample per year and when terminating.
- o *Tritium*. Sample frequency is outlined in Radiation and Contamination Control DPSOP 40-1 or Construction Job Plans.
- o *Plutonium*. One sample every 3 years and when terminating.
- o *Other Nuclides*. As specified by area Health Physics in Construction Job Plans.

NOTE: Construction Division Medical Department annually provides each employee with a sample bottle and label and instructs the employee to submit a one-liter urine sample. Samples are also obtained from new employees who worked in Radiation Zones at another installation where radioactive materials were handled. Personnel Monitoring will forward requests for resamples through Construction Medical.

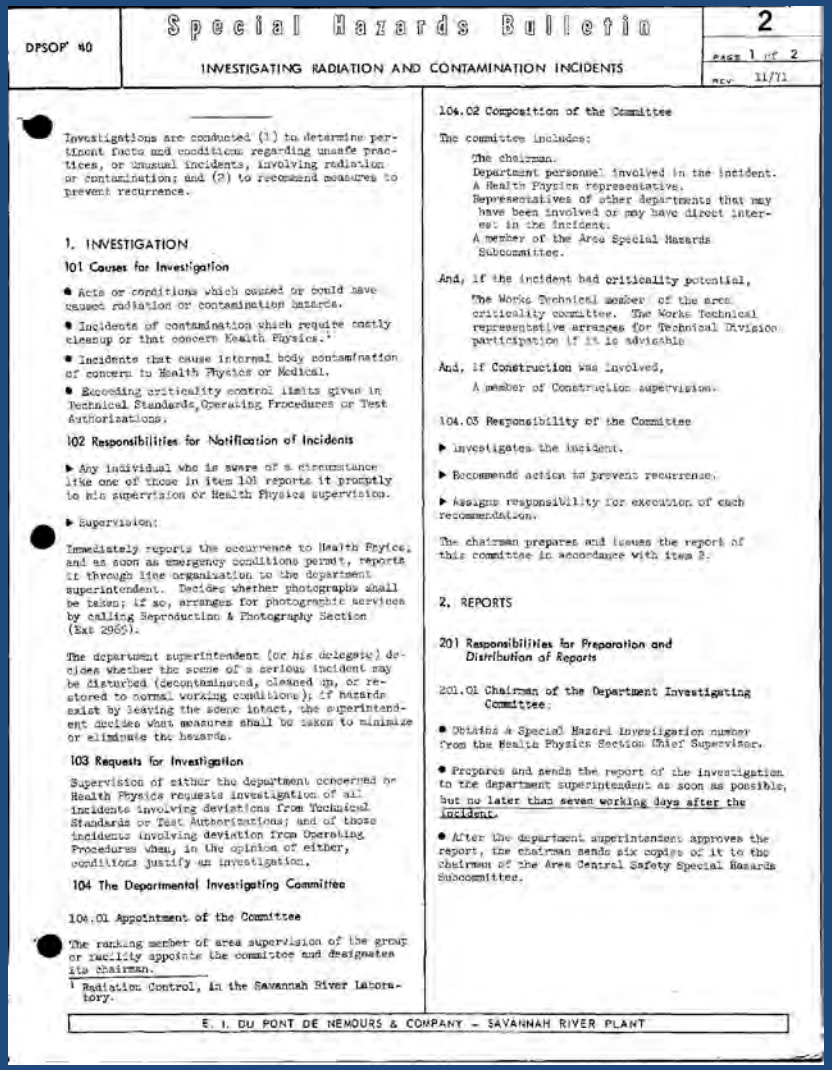
2.2 Special Sampling.
See division C and Construction Division Safety Procedure 58.

DPSOL 193-302T (Rev 0 1985)

Bioassay Control Summary

- Monitoring prescribed by work area
- Monitoring frequency is based on potential for exposure
- Post 1978 - Neptunium urine bioassay for highest exposure potential area (235F)

SHB #2 - Radiological Incidents



DPSOP 40

Special Hazards Bulletin

2

INVESTIGATING RADIATION AND CONTAMINATION INCIDENTS

PAGE 1 of 2

REV. 11/71

Investigations are conducted (1) to determine pertinent facts and conditions regarding unsafe practices, or unusual incidents, involving radiation or contamination; and (2) to recommend measures to prevent recurrence.

1. INVESTIGATION

101 Causes for Investigation

- Acts or conditions which caused or could have caused radiation or contamination hazards.
- Incidents of contamination which require costly cleanup or that concern Health Physics.[1]
- Incidents that cause internal body contamination of concern to Health Physics or Medical.
- Exceeding criticality control limits given in Technical Standards, Operating Procedures or Test Authorizations.

102 Responsibilities for Notification of Incidents

▶ Any individual who is aware of a circumstance like one of those in item 101 reports it promptly to his supervision or Health Physics supervision.

▶ Supervision:

Immediately reports the occurrence to Health Physics and as soon as emergency conditions permit, reports it through line organization to the department superintendent. Decides whether photographs shall be taken; if so, arranges for photographic services by calling Reproduction & Photography Section (Ext 2965).

The department superintendent (or his delegate) decides whether the scene of a serious incident may be disturbed (decontaminated, cleaned up, or restored to normal working conditions); if hazards exist by leaving the scene intact, the superintendent decides what measures shall be taken to minimize or eliminate the hazards.

103 Requests for Investigation

Supervision of either the department concerned or Health Physics requests investigation of all incidents involving deviations from Technical Standards or Test Authorizations; and of those incidents involving deviation from Operating Procedures when, in the opinion of either, conditions justify an investigation.

104 The Departmental Investigating Committee

104.01 Appointment of the Committee

The ranking member of area supervision of the group or facility appoints the committee and designates its chairman.

104.02 Composition of the Committee

The committee includes:

The chairman.
Department personnel involved in the incident.
A Health Physics representative.
Representatives of other departments that may have been involved or may have direct interest in the incident.
A member of the Area Special Hazards Subcommittee.

And, if the incident had criticality potential,

The Works Technical member of the area criticality committee. The Works Technical representative arranges for Technical Division participation if it is advisable.

And, if Construction was involved,

A member of Construction supervision.

104.03 Responsibility of the Committee

▶ Investigates the incident.

▶ Recommends action to prevent recurrence.

▶ Assigns responsibility for execution of each recommendation.

The chairman prepares and issues the report of this committee in accordance with item 2.

2. REPORTS

201 Responsibilities for Preparation and Distribution of Reports

201.01 Chairman of the Department Investigating Committee:

- Obtains a Special Hazard Investigation number from the Health Physics Section Chief Supervisor.
- Prepares and sends the report of the investigation to the department superintendent as soon as possible, but no later than seven working days after the incident.
- After the department superintendent approves the report, the chairman sends six copies of it to the chairman of the Area Central Safety Special Hazards Subcommittee.

[1] Radiation Control, in the Savannah River Laboratory.

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1. INVESTIGATION

101 Causes for Investigation

- Acts or conditions which caused or could have caused radiation or contamination hazards.
- Incidents of contamination which require costly cleanup or that concern Health Physics.[1]
- Incidents that cause internal body contamination of concern to Health Physics or Medical.
- Exceeding criticality control limits given in Technical Standards, Operating Procedures or Test Authorizations.

102 Responsibilities for Notification of Incidents

▶ Any individual who is aware of a circumstance like one of those in item 101 reports it promptly to his supervision or Health Physics supervision.

Radiological Incident Reporting

- Special Hazards Investigations (SHI)
  - Serious incidents – Initiated upon request from either Department or Health Physics
- Department or Area Incident reports
  - DPSP Reports (Reactor Incidents, Separations, etc…)
  - DPST Reports (Technical Area – 773A)
- Health Physics Logbooks

Neptunium Incidents

HB-Line (Jan 1972)

One construction worker continued installation of Pu-Np partitioning equipment in the JT·3 process cabinet in Room 311. Transferable contamination was measured up to 10e8 dpm/ft^2 and gamma radiation exposure rates to 100 mR/hr were measured in the cabinet. Plastic suits were worn for personnel protection and containment huts were used for contamination control. Even with these precautions, as one employee undressed following work, he contaminated his hair to 80,000 dpm and his right cheek to 30,000 dpm. A second employee contaminated his coveralls to 40,000 dpm when a seam in his plastic suit failed. Bioassay analyses indicated that neither employee assimilated radioactive materials (SRDB 68265).

Neptunium Incidents

235F (Nov. 1974)

Two Maintenance mechanics and a Separations operator received nasal contamination to 420 dpm, 25 dpm, and 30 dpm, respectively, due to a process cabinet glove failure while working in the Neptunium Compact Operating Room. The Maintenance mechanic with the highest nasal contamination also had contamination to 10,000 dpm on his wrist. There were five other persons in the room at the time; their nasal smears were negative. Bioassay sampling for the three persons with positive nasal smears were initiated. A survey of the room one failed glove and 14 contaminated gloves. The failed glove was contaminated to 8,000,000 dpm alpha with levels to 100,000 dpm on the other 14 [gloves]. The floor was contaminated up to 100,000 dpm/ft^2 (SRDB 68041).

Neptunium Incidents

235F (Oct. 1978)

An operator working in the neptunium line incurred nasal contamination of 190 dpm when a cabinet glove failed. The glove was contaminated to 10,000 dpm and the floor to 2000 dpm/0.1 m^2. Room airborne activity remained less than RCG during the incident. Nasal irrigation promptly removed the contamination. A follow-up chest count of the operator indicated less than the minimum detectable amount and urine sample results were negative (SRDB 68282).

Neptunium Incidents

321M (Nov. 1978)

Alpha contamination to 200,000 dpm was detected in a 1.5 mm wide and 1.5 cm long crack on the cladding of an extruded neptunium tube. No transferable or airborne contamination was detected. Gamma exposure rates to 200 mR/hr were measured 45 cm from the tube (SRDB 68347).

Neptunium Incidents

321M (Jun. 1980)

Transferable contamination to 3,000,000 dpm alpha/1000 cm^2 was detected on the hood furnace floor, valves, and manifold fittings upon completion of neptunium billet outgassing. No particulate airborne radioactivity was detected in the work area. Employees wore appropriate respiratory protection. All equipment was decontaminated to less than 500 dpm alpha/1000 cm^2 (SRDB 68325)

Radiological Controls (1990-2007)

- Radiation Work Permit System implemented in 1990
- SRS implemented a new radiation control manual (WSRC-5Q) in 1991 to comply with DOE Order 5480.11, it was updated as follows to comply with:
  - 1992 DOE Radiological Control Manual DOE N 5480.6
  - 1994 DOE Radiological Control Manual DOE/EH-0256T
  - 1995 Occupational Radiation Protection 10CFR835

Neptunium Monitoring Data

- Three time periods
  - 1961 – 1969: Urinalysis (separations, gross alpha)
  - 1970 – 1989: Limited Urinalysis (Whole Body Counts)
  - 1990 – present: Urinalysis (alpha spec)

- DPSOL 193-302 and DPSOL 193-211
  - Monitoring prescribed by area
  - Monitoring prescribed for Construction workers
    - Job Plans prescribe for non-routine exposures

Neptunium Monitoring Data

Year	# of Neptunium Samples Identified in Works Technical Reports	# of Neptunium Urine Samples located in other Pu, EU, Am Logbooks
1972	22	20
1973	31	17
1974	42	18
1975	No Listing in Report	
1976	No Listing in Report	
1977	No Listing in Report	
1978	No Listing in Report	
1979	11	1
1980	48*	49
1981	57	19
1982	146	78
1983	22*	25
1984	37*	48
1985	13*	14
1986	No Summary Report	
1987	No Summary Report	
1988	No Summary Report	30
1989	No Summary Report	14

* Only partial year information currently available

Neptunium Monitoring Data

- 333 Np urine samples
- Area frequency based on exposure potential
- Most are from 235F

Year	Number of Samples by Area				
	235-F	HB Line	321M	773/772-F	other
1972	20				
1973	16		1		
1974	17			1	
1975					
1976					
1977					
1978					
1979			1		
1980	36		8	3	2
1981	3	2	9	3	2
1982	36	32	6	3	1
1983	12	4		7	2
1984	23	5	16	4	
1985	7	2		3	2
1986					
1987					
1988	5	5		16	4
1989	3			9	2
Total	178	50	41	49	15

Np Dose Reconstruction Methods

- At least four methods that NIOSH could use to develop a co-worker model in order to estimate Np exposures in the 1970 to 1990 timeframe:
  1. Use the limited bioassay
  2. Ratio Np from the Pu bioassay given that the Pu activity is between 2-10 times greater than Np activity (best estimate for an epidemiology studies)
  3. Interpolate between urine bioassay points between 1969 and 1990
  4. Use whole body count data to develop co-worker model (most claimant favorable)

NIOSH Co-worker Model

- NIOSH chose to use whole body count information because:
  - At the time NIOSH didn't have complete information on the actual Pu:Np ratio (data has now been copied)
  - NIOSH had confirmed that workers in Np areas were required to have whole body counts
    - Shift employees - 2/year
    - Day employees - 1/year
  - Np doses calculated using WBC (Whole Body Count) are claimant favorable upper bounds but not unreasonably high as to be insufficiently accurate

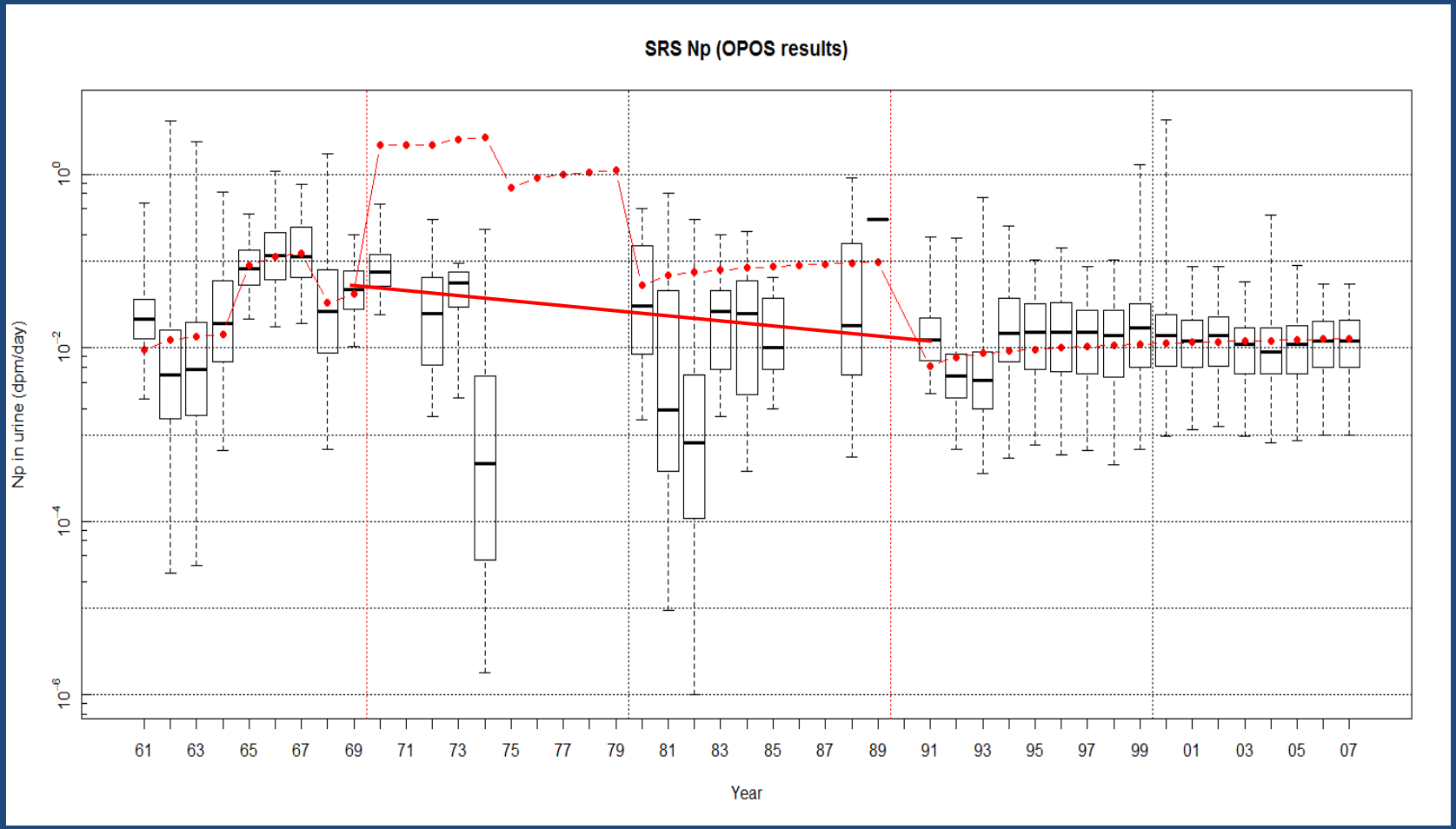
NIOSH Co-worker Model

- **50 year equivalent doses**

Organ	50-Year Equivalent Dose (rem)
Urinary Bladder	0.352
Breast	0.352
Kidneys	0.958
Liver	4.280
Red Bone Marrow	10.300
Bone Surface	268.000
Stomach	0.352
Lung	6.920

Even the 268 rem / 50 years = approximately 5 rem / year

Np Co-worker Model and Bioassay



Np Co-worker Model Comparison

ORAUT-RPRT-0056

- **Stratified the monitored workforce**
  - **Construction Trades Workers (CTWs)**
  - **Non-Construction Trades Workers (nCTWs)**
  - **Unknowns** ***(no unknowns from 1974-1989)***
- **Developed two co-workers models**
  - **CTW Model**
  - **nCTW Model**

Np Co-worker Model Comparison

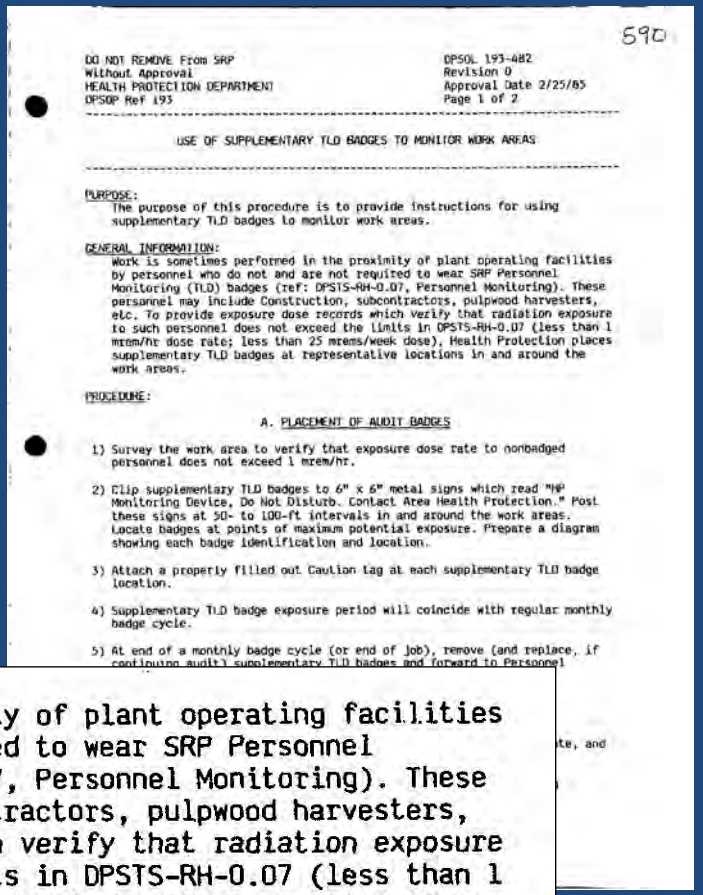
- Peto-prentice test
- Significance level
  - $p < 0.05$
- Since no comparison year was less 0.05 we could not conclude that they were different
- Comparison methodology is being discussed in SEC Workgroup

Period	p-value CTW:nonCTW
1961	0.243
1962	0.899
1963	0.075
1974	0.876
1975	0.075
1977	0.975
1978	0.516
1979	0.666
1980	0.821
1981	0.310
1983	0.235
1984	0.850
1985	0.441
1986	0.685
1987	0.445
1988	0.142
1989	0.288

Construction Exposures

- **Construction Personnel Monitoring**
  - Dosimeters required for regulated areas
  - Construction worker interviews:

    "Regulated Area posted one day and then postings removed for construction work."



590

DO NOT REMOVE From SRP
Without Approval
HEALTH PROTECTION DEPARTMENT
DPSOP Ref 193

DPSOL 193-482
Revision 0
Approval Date 2/25/85
Page 1 of 2

USE OF SUPPLEMENTARY TLD BADGES TO MONITOR WORK AREAS

PURPOSE:
The purpose of this procedure is to provide instructions for using supplementary TLD badges to monitor work areas.

GENERAL INFORMATION:
Work is sometimes performed in the proximity of plant operating facilities by personnel who do not and are not required to wear SRP Personnel Monitoring (TLD) badges (ref: DPSTS-RH-0.07, Personnel Monitoring). These personnel may include Construction, subcontractors, pulpwood harvesters, etc. To provide exposure dose records which verify that radiation exposure to such personnel does not exceed the limits in DPSTS-RH-0.07 (less than 1 mrem/hr dose rate; less than 25 mrems/week dose), Health Protection places supplementary TLD badges at representative locations in and around the work areas.

PROCEDURE:

A. PLACEMENT OF AUDIT BADGES

1) Survey the work area to verify that exposure dose rate to nonbadged personnel does not exceed 1 mrem/hr.

2) Clip supplementary TLD badges to 6" x 6" metal signs which read "HP Monitoring Device, Do Not Disturb. Contact Area Health Protection." Post these signs at 50- to 100-ft intervals in and around the work areas. Locate badges at points of maximum potential exposure. Prepare a diagram showing each badge identification and location.

3) Attach a properly filled out Caution tag at each supplementary TLD badge location.

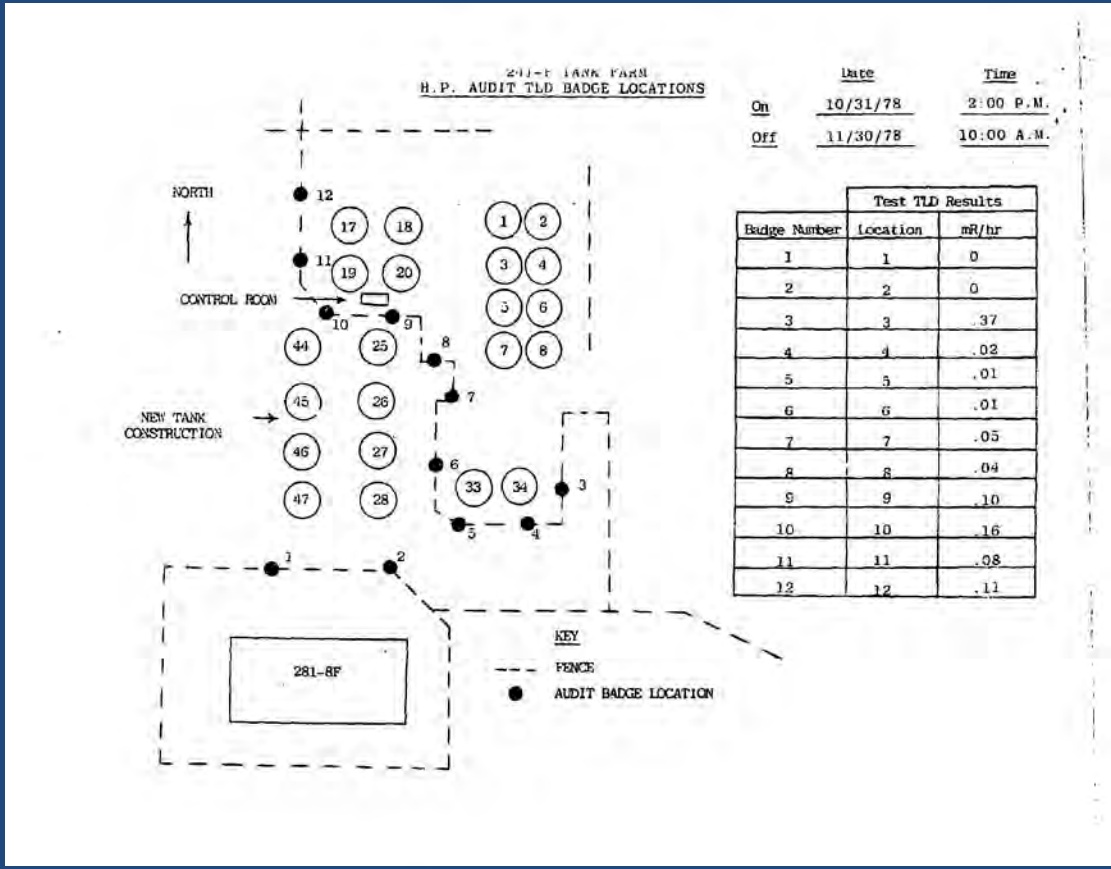
4) Supplementary TLD badge exposure period will coincide with regular monthly badge cycle.

5) At end of a monthly badge cycle (or end of job), remove (and replace, if continuing audit) supplementary TLD badges and forward to Personnel

te, and

GENERAL INFORMATION:
Work is sometimes performed in the proximity of plant operating facilities by personnel who do not and are not required to wear SRP Personnel Monitoring (TLD) badges (ref: DPSTS-RH-0.07, Personnel Monitoring). These personnel may include Construction, subcontractors, pulpwood harvesters, etc. To provide exposure dose records which verify that radiation exposure to such personnel does not exceed the limits in DPSTS-RH-0.07 (less than 1 mrem/hr dose rate; less than 25 mrems/week dose), Health Protection places supplementary TLD badges at representative locations in and around the work areas.

Supplemental TLD Badges for Construction



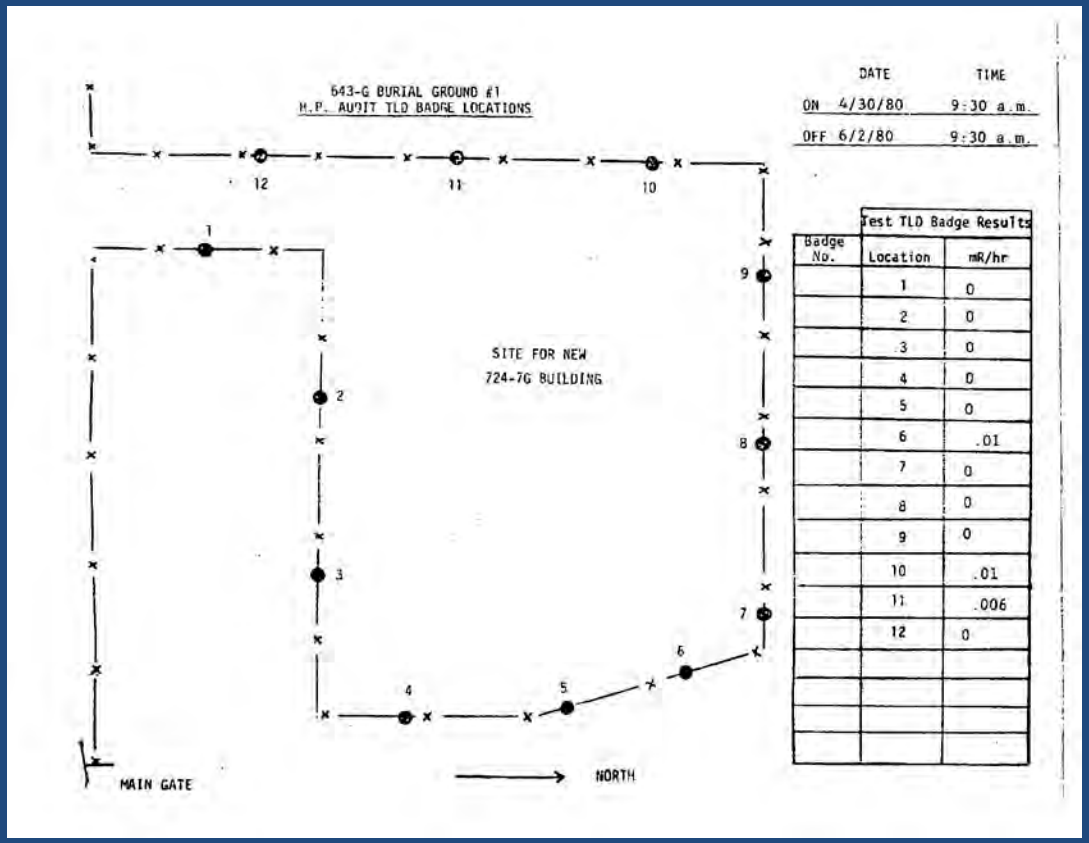
281-F TANK FARM
H.P. AUDIT TLD BADGE LOCATIONS

	Date	Time
On	10/31/78	2:00 P.M.
Off	11/30/78	10:00 A.M.

	Test TLD Results	
Badge Number	Location	mR/hr
1	1	0
2	2	0
3	3	.37
4	4	.02
5	5	.01
6	6	.01
7	7	.05
8	8	.04
9	9	.10
10	10	.16
11	11	.08
12	12	.11

SRDB: 56619 p.131

Supplemental TLD Badges for Construction

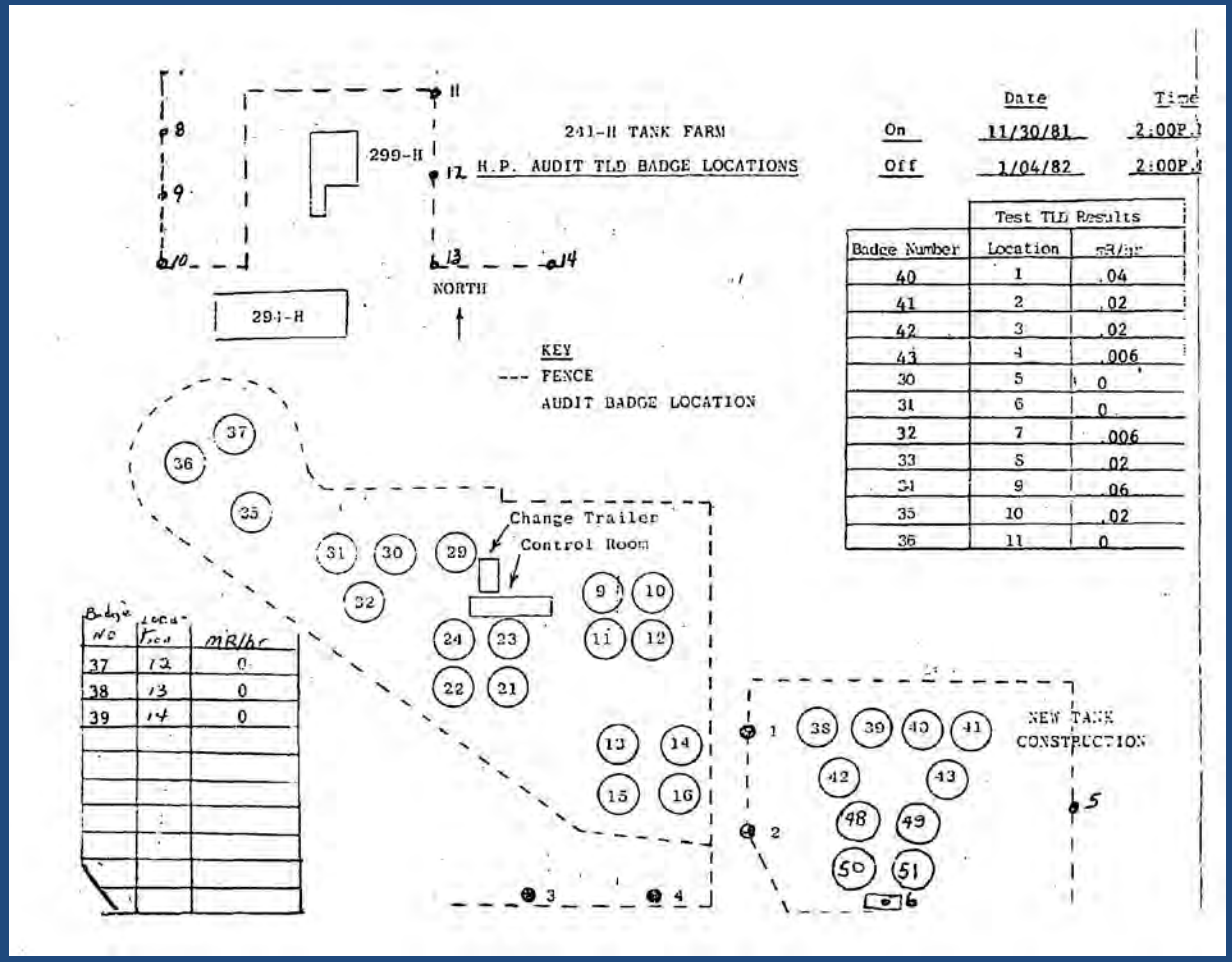


	DATE	TIME
ON	4/30/80	9:30 a.m.
OFF	6/2/80	9:30 a.m.

Badge No.	Test TLD Badge Results	
	Location	mR/hr
	1	0
	2	0
	3	0
	4	0
	5	0
	6	.01
	7	0
	8	0
	9	0
	10	.01
	11	.006
	12	0

SRDB: 56619 p.170

Supplemental TLD Badges for Construction



241-H TANK FARM
H.P. AUDIT TLD BADGE LOCATIONS

	Date	Time
On	11/30/81	2:00P.M.
Off	1/04/82	2:00P.M.

	Test TLD Results	
Badge Number	Location	mR/hr
40	1	.04
41	2	.02
42	3	.02
43	4	.006
30	5	0
31	6	0
32	7	.006
33	8	.02
34	9	.06
35	10	.02
36	11	0

299-H
294-H
NORTH
KEY
--- FENCE
AUDIT BADGE LOCATION
Change Trailer
Control Room
NEW TANK CONSTRUCTION

Badge NO	Location	mR/hr
37	12	0
38	13	0
39	14	0

SRDB: 56619 p.88

Construction Worker Exposures

- Radiological records and construction personnel interviews are actually consistent.
- There are times when construction trades were not monitored because of low potential.
- There are times when construction trades were monitored but did not know it. The monitoring was of the workplace not them personally.
- In the case of Np due to the very high photon dose rate we contend that all CTWs that had a potential for neptunium exposure were personally monitored.