

# Idaho National Laboratory Special Exposure Cohort Petition Evaluation Report SEC-00219

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Richland, Washington

# ORAU Evaluation Team

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- **Jason Davis (Chemical Processing Plant)**
- **Brian Gleckler (Test Area North)**
- **Data Capture Support Team**
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# Petition Overview

- **Petitioner is an authorized representative for Energy Employee**
- **Petition Received on July 8, 2014**
- **Petition Qualified on September 16, 2014**
- **Notification to Petitioner and ABRWH on January 20, 2015 that NIOSH would exceed 180 day deadline due to site complexity and need for multiple data capture efforts onsite and at Federal Records Center in Seattle.**
- **Evaluation Report sent to ABRWH on March 12, 2015**
- **Evaluation Report sent to Petitioner March 19, 2015**

# Petition Overview cont.

- **Preliminary Class:** *All employees who worked in any area of the Idaho National Laboratory from January 1, 1949 through December 31, 1970*
- **Petitioner Basis:** *There was no internal monitoring for plutonium, neptunium, or fission products*
- **NIOSH qualified the petition based on limited monitoring for plutonium and neptunium. Current dose reconstruction method for plutonium is based on ratio from mixed fission products.**

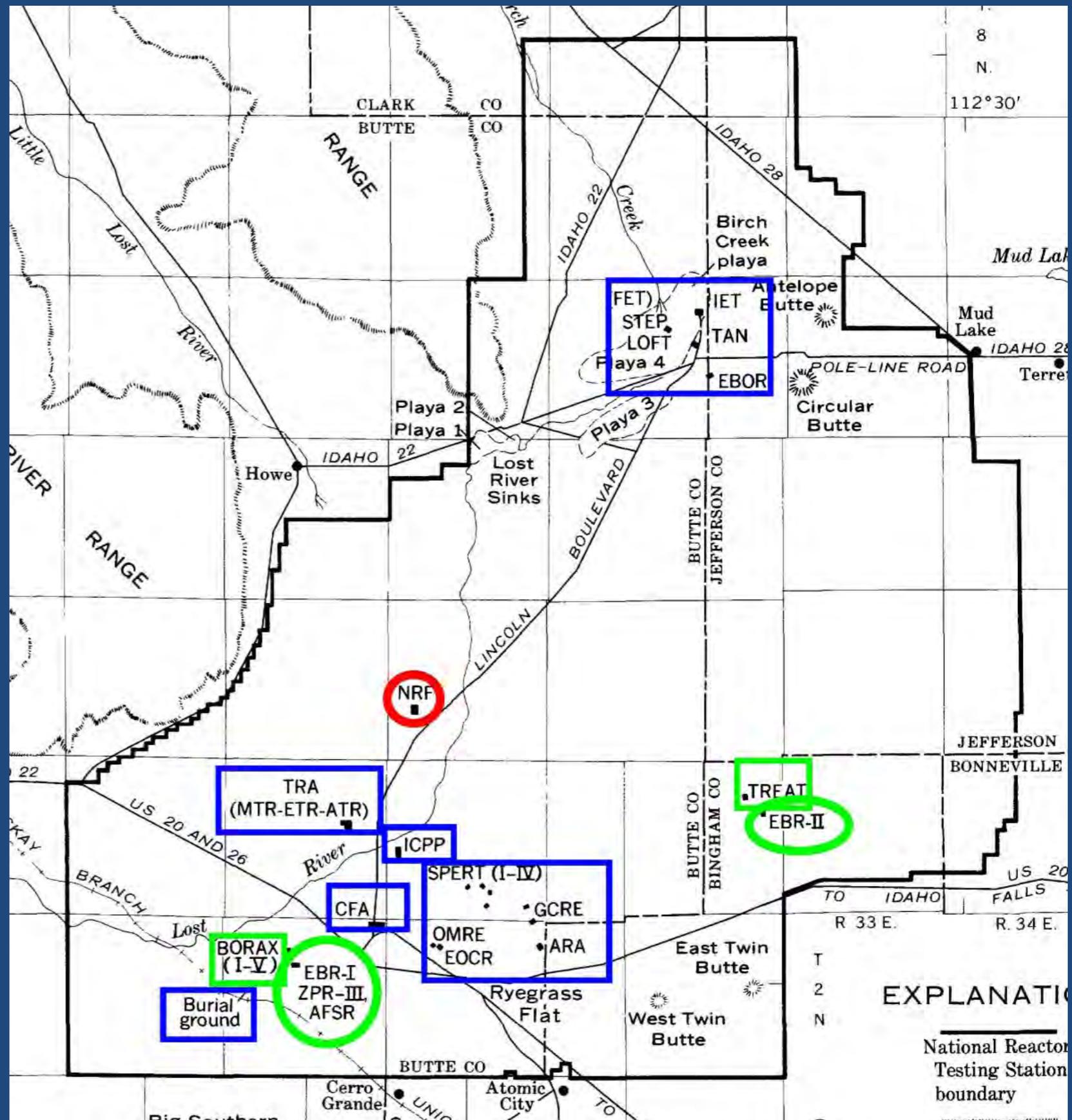
# Proposed Class Definition

*All employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the Idaho National Laboratory in Scoville, Idaho, and were monitored for external radiation at the Idaho Chemical Processing Plant (CPP) (e.g., at least one film badge or TLD dosimeter from CPP) between January 1, 1963 and December 31, 1974 for a number of work days aggregating at least 250 work days, occurring either solely under this employment, or in combination with work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort.*

# INL Site Complexity

- Petition originally included both INL and ANL-W
- Petition split November 25, 2014 due to DOE facility definitions.
  - INL operated 1949 - present
  - ANL-W operated 1949 – 2005
- DCAS received new petition for ANL-W on December 4, 2014
- ANL-W Petition (SEC00224) is in qualification process
- Current Evaluation (SEC00219) is for just INL facilities.

# INL Operating Areas



# INL Operating Areas

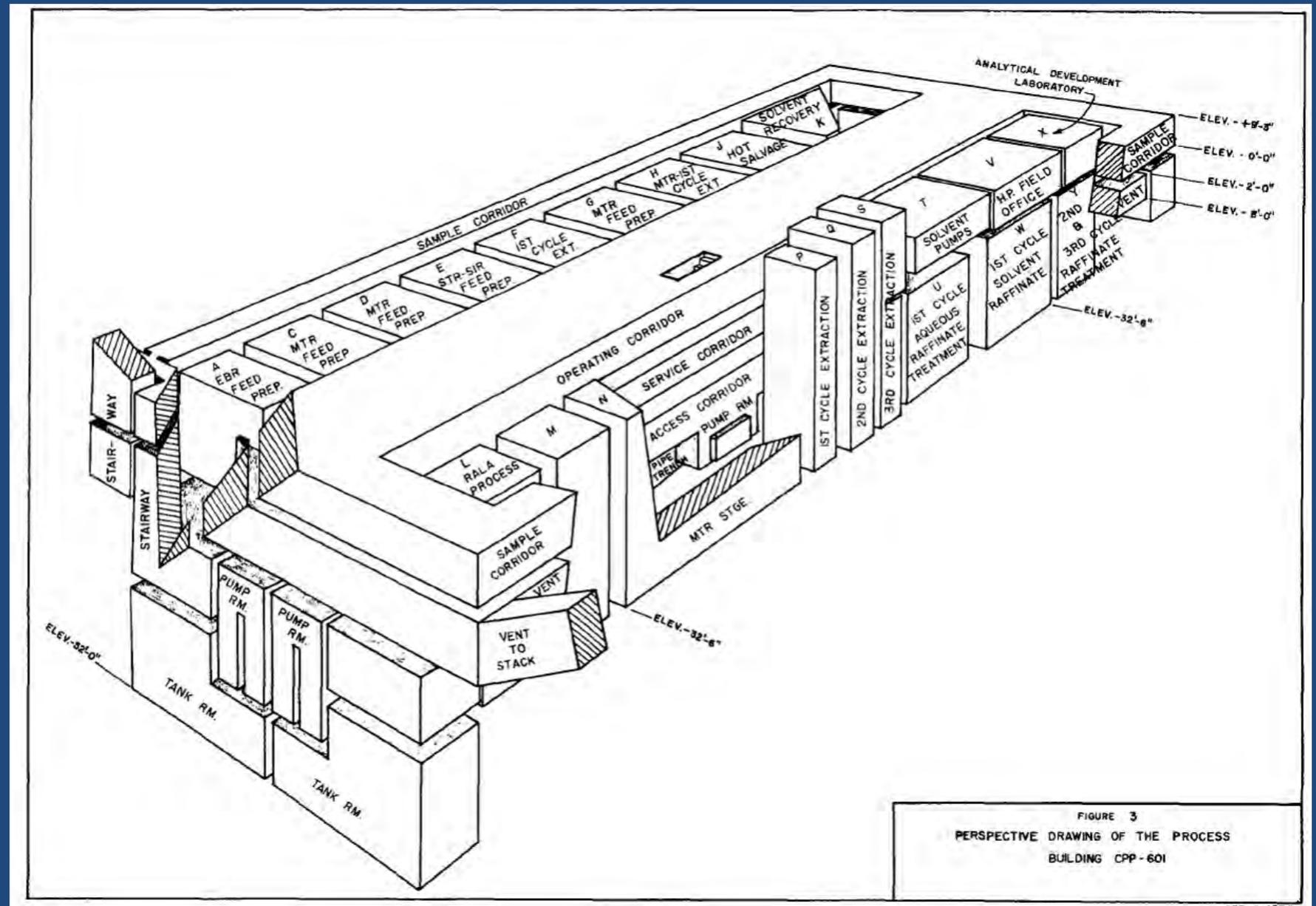
1. Chemical Processing Plant (CPP)
2. Test Reactor Area (TRA)
3. Test Area North (TAN)
4. Misc. Reactor Areas (SPERT, ARA, OMRE)
5. Central Facilities Area (CFA)
6. Burial Grounds

# Chemical Processing Plant (CPP)

- Enriched Uranium (U235) Reprocessing Facility (601)
- Analytical Laboratories (602)
- Fuel Storage Building (603)
- Remote Analytical Facility (627)
- Solvent Burning Building
  - Burning Used Solvent
- Calcination Building (633)
  - (Liquid waste conversion to solid waste)

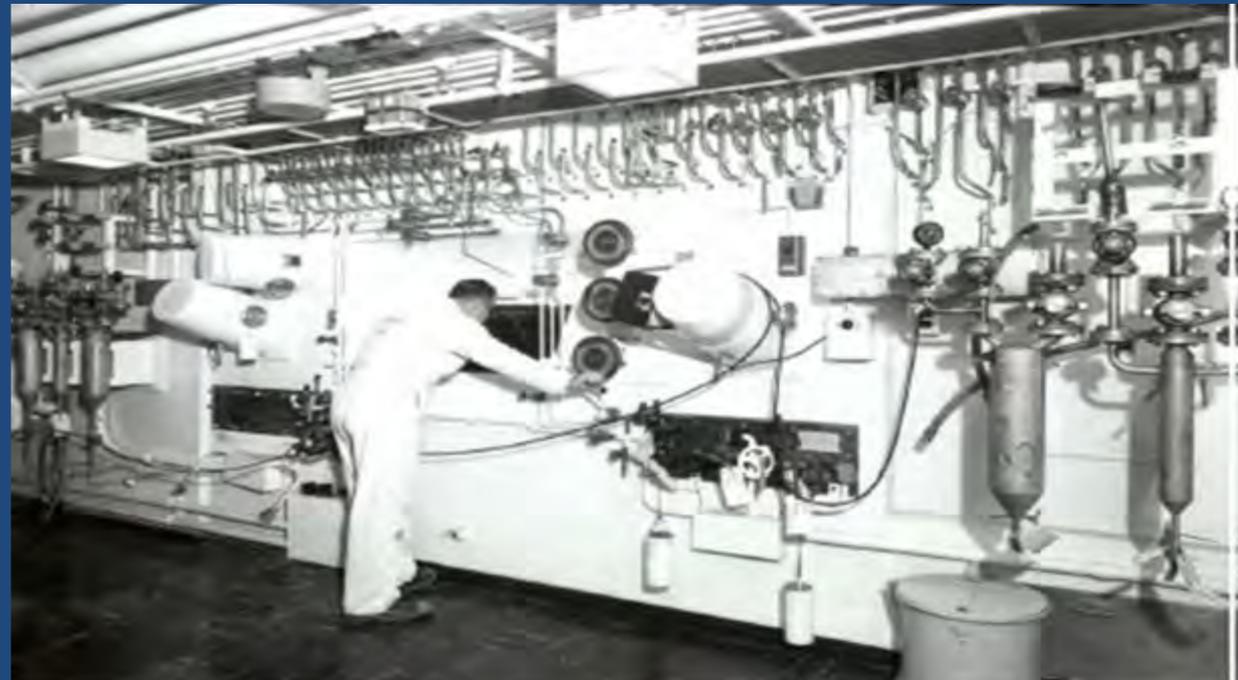
# Reprocessing Facility (601)

- Process make-up
- Operations corridor
- Sampling corridor
- Service corridor
- Access corridor



# Reprocessing Facility (601)

- First Stage separation of mixed fission products
- Second and Third Stages separate remaining fission products and plutonium from uranium
- Generally plutonium raffinate sent to waste tanks
- One campaign to separate plutonium and neptunium (1965-1972)



# Np and Pu Separations Campaign

- Np and Pu raffinate was stored in N Cell
- Took over 6 years to fill tank with enough solution to process
- Activities during the six years
  - Sampling Np and Pu concentration with each U235 campaign
  - Chemical separations experiments in Analytical Chemistry Laboratories (602)
  - Interview with Chemist indicated it was a short duration research as they pretty much knew how to separate and purify.

# Np and Pu Separations Campaign

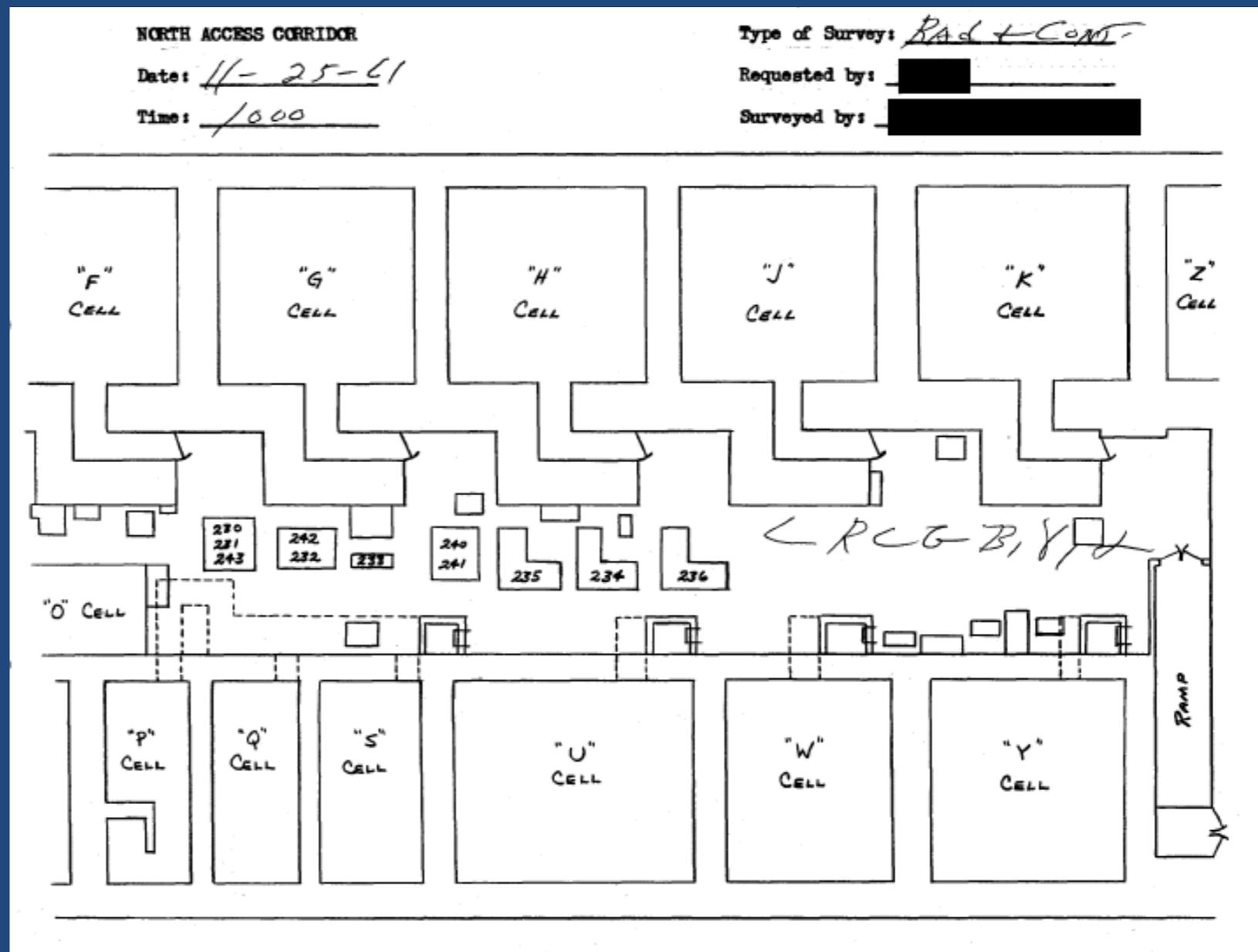
- Processing was conducted during 3 week campaign in June 1972
  - Solution pumped to P Cell for uranium extraction
  - Solution pumped to J Cell with new piping for transfer to Multi-Curie Cell (MCC) for loading into 10 liter (L-10) bottles
  - A total of 14 L-10 bottles were used thus the total solution was about 140 liters.
  - Total mass:      Np = 5412g  
                         Pu = 544g  
                         U = 293g
- One worker did the physical transfer but several observed.

# Umpire Qualification Program

- Round-robin Testing of Analytical Chemistry Laboratories to resolve differences between shipping and receiving laboratories.
- CPP awarded contract to manage program in May 1965
  - K-25 and CPP prepared uranium standards
  - Rocky Flats and Hanford prepared plutonium standards
- Exposure potential during this program is minimal. Standards were received and simply shipped to other facilities for evaluation.
- Several of the analytical laboratory personnel were monitored for plutonium exposure.

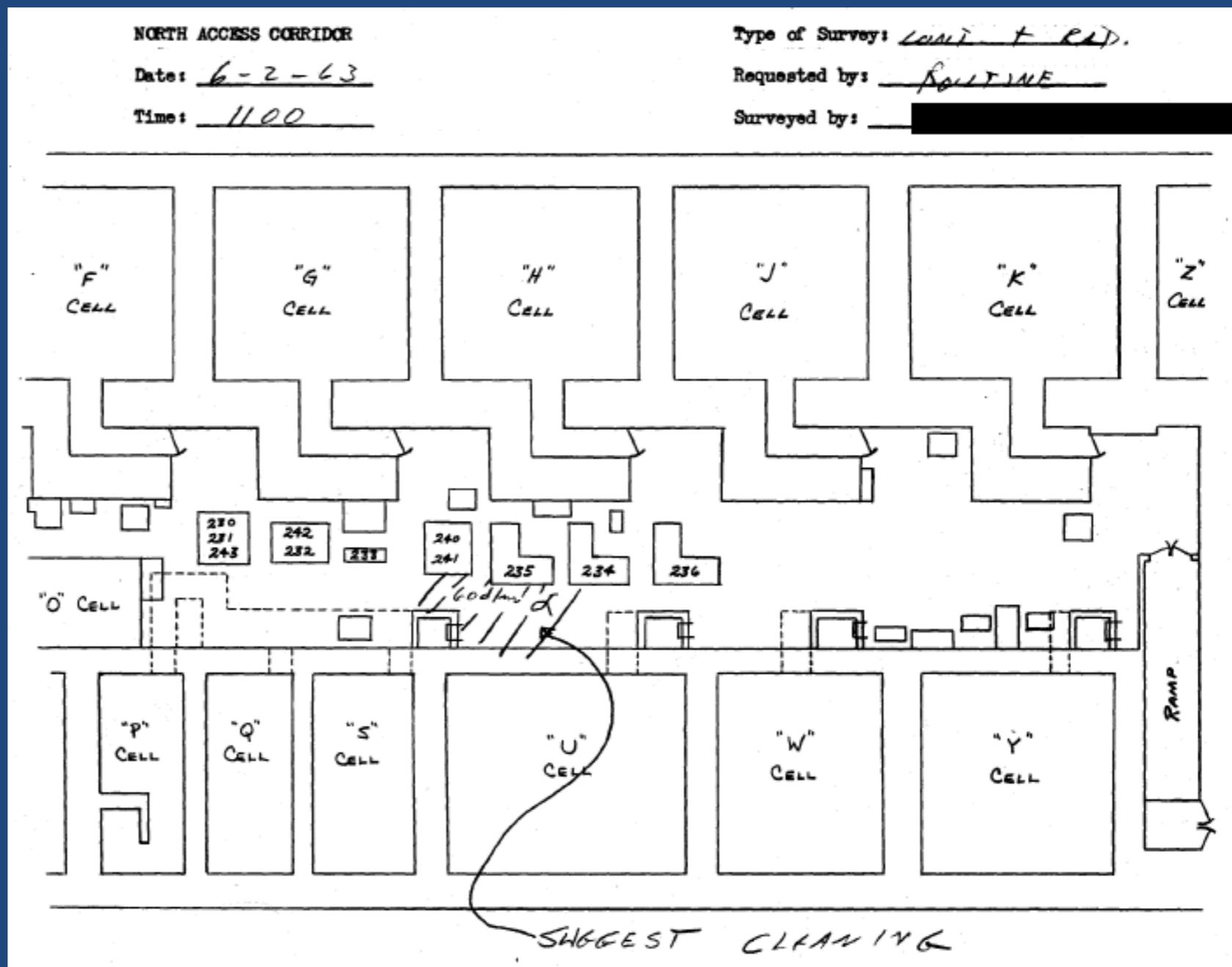
# Degradation of Radiological Control

In 1961, good control of contamination. All levels were less than Radiation Control Guidelines 20 dpm for alpha



# Degradation of Radiological Control

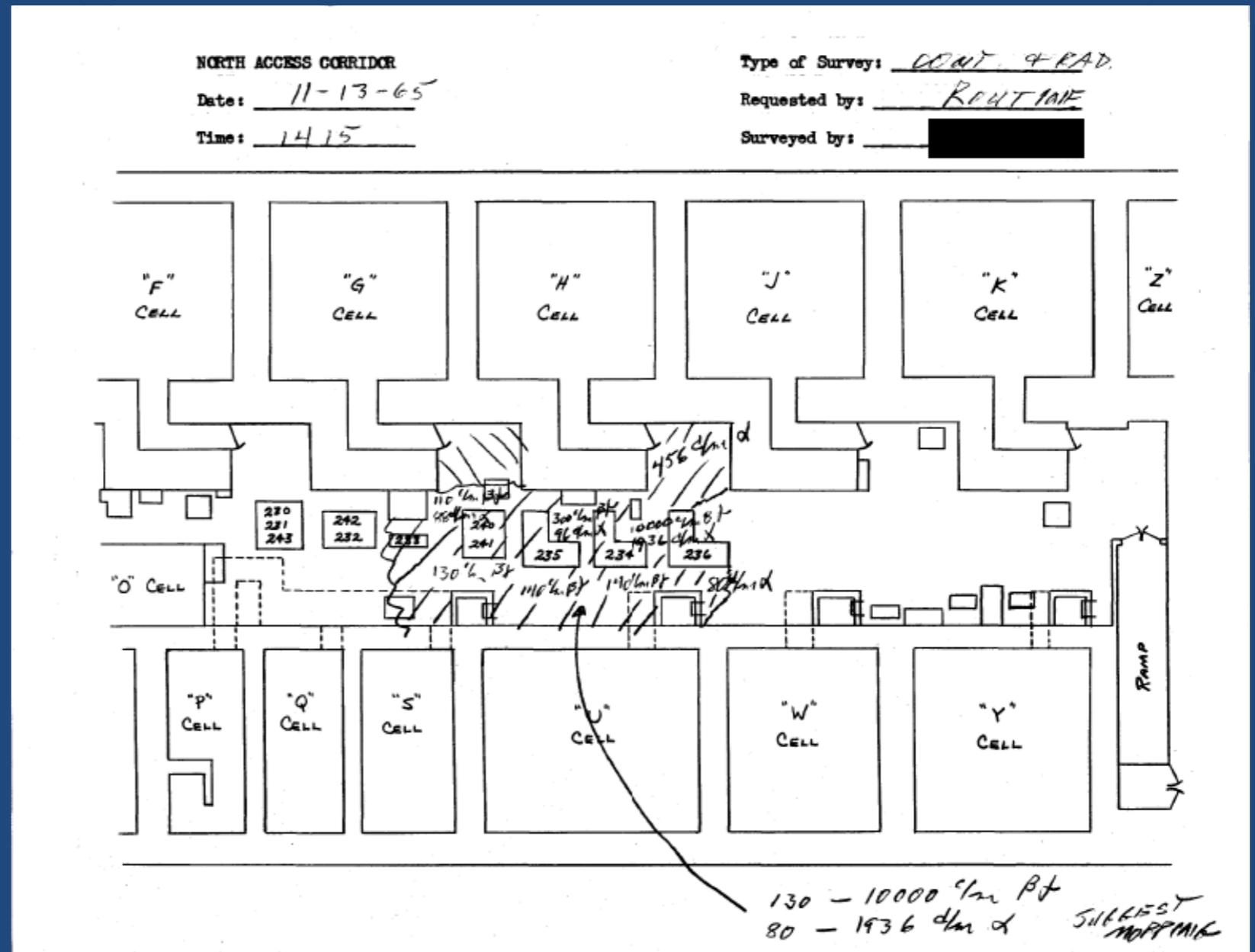
In 1963 there don't appear to be severe contamination issues but perhaps the beginning of a slow degradation. (e.g. times when area is clean, times when area is contaminated.)



# Degradation of Radiological Control

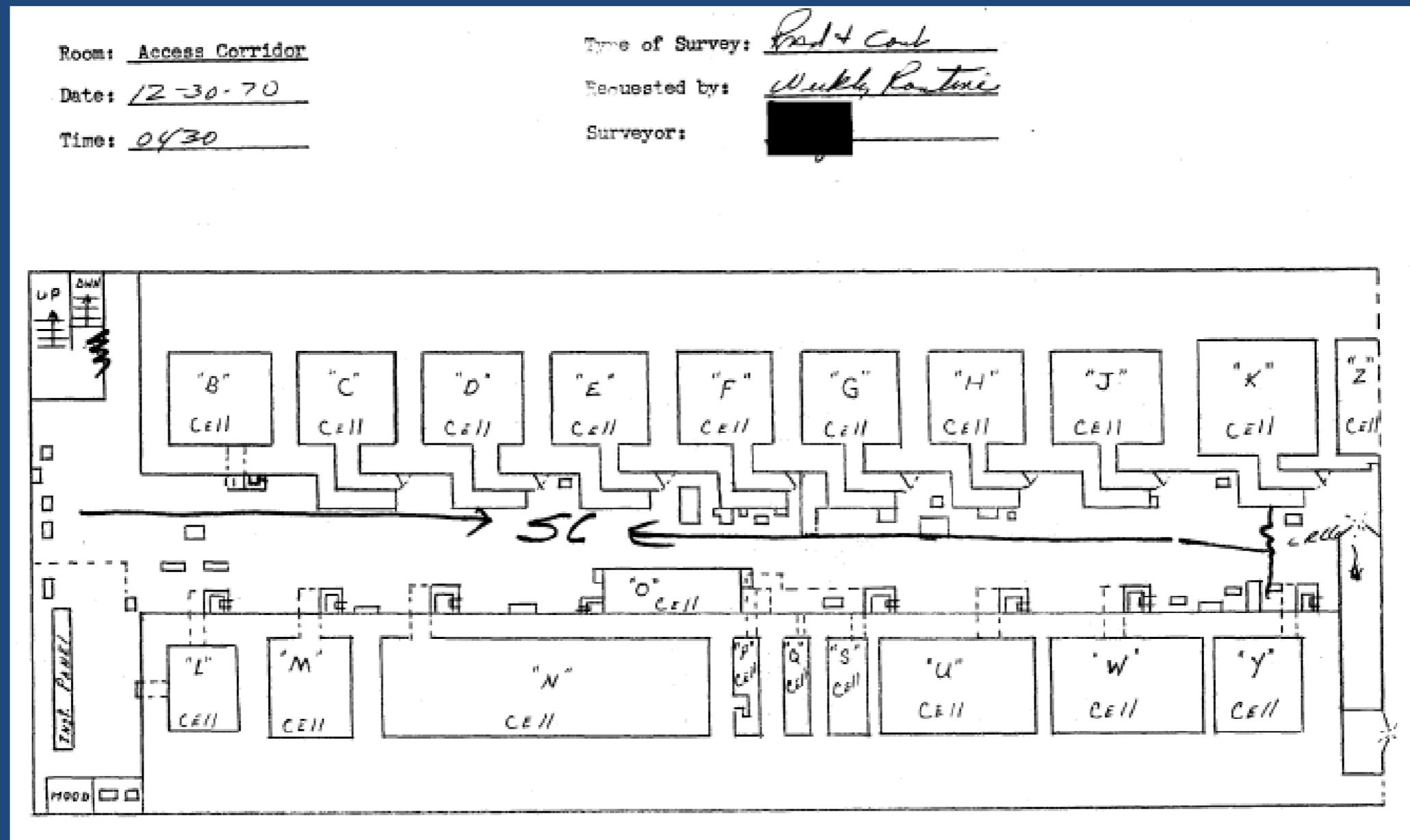
In 1965  
contamination  
control is getting  
worse with levels  
near 100 times the  
RCG.

A 1968 audit  
indicates poor  
control of  
contamination and  
lack of surveys.



# Degradation of Radiological Control

- In 1970 widespread contamination throughout corridor



# Degradation of Radiological Control

- **November 1972, Plutonium intake in Analytical Laboratories**
  - Contamination was found, bioassay follow-up was conducted
  - One individual had a “different” Pu-238 to Pu-239 ratio indicating a previously unmonitored and undetected intake of plutonium.
  - Incident report concluded that the intake occurred during a May 1972 cleaning of X Cell (six months prior).
  - Survey logs of X cell indicate alpha contamination levels of a few thousand dpm after mopping.

# Degradation of Radiological Control

- INL Committee formed to evaluate contamination control issues and recommend programmatic upgrades.
  - ACI-167 Preliminary ICPP Health Physics Upgrade Program Report issued October 1974

## 1.3 CPP-601 Access Corridor

The access corridor is contaminated routinely to several thousand dpm/100 cm<sup>2</sup>. A specific contributing problem is the centrifuge; however, contamination potential exists from each of the cells, which are highly contaminated. The greatest contamination potential exists as a result of spills or during plant shutdown periods when the centrifuge shielding is removed, or cells are entered, etc. However, general levels in the corridor during normal operations require protective clothing and contamination control barriers routinely. Significant levels (>10<sup>5</sup> dpm/100 cm<sup>2</sup>) of Pu contamination have been identified recently in a number of cells (eg, Cells D, Y, and K).

# Degradation of Radiological Control

## 1.8 Analytical Laboratories

High levels of contaminants are handled routinely and analyzed in a variety of facilities ranging from Remote Analytical Facilities and transuranic glove boxes to hoods and bench tops. Higher than usual (other nuclear facilities) activity is handled on open bench tops and hoods presently. Compared to analytical facilities at some other sites, contamination spread and personnel exposure potential are significant.

*ACI-167 Preliminary ICPP Health Physics Upgrade Program Report*

# Degradation of RadCon

Bioassay samples (fecal and urine) are collected and analyzed presently only when an exposure incident is suspected. The typical problems have been encountered in obtaining the exposed personnel cooperation necessary to provide samples as requested and to furnish all of the necessary information.

A routine bioassay program is being developed. A draft of SOP 1.6.5.22, "ICPP Bioassay Program," has been prepared. The proposed program recommends the collection and analysis of about 350 bioassay samples per year. Of these, 50 would be fecal samples to be analyzed for plutonium and/or uranium, 50 would be urine samples to be analyzed for plutonium, and the remaining 250 would be urine samples to be analyzed for total uranium and fission products. The

*ACI-167 Preliminary ICPP Health Physics Upgrade Program Report*

# CPP Recommendation

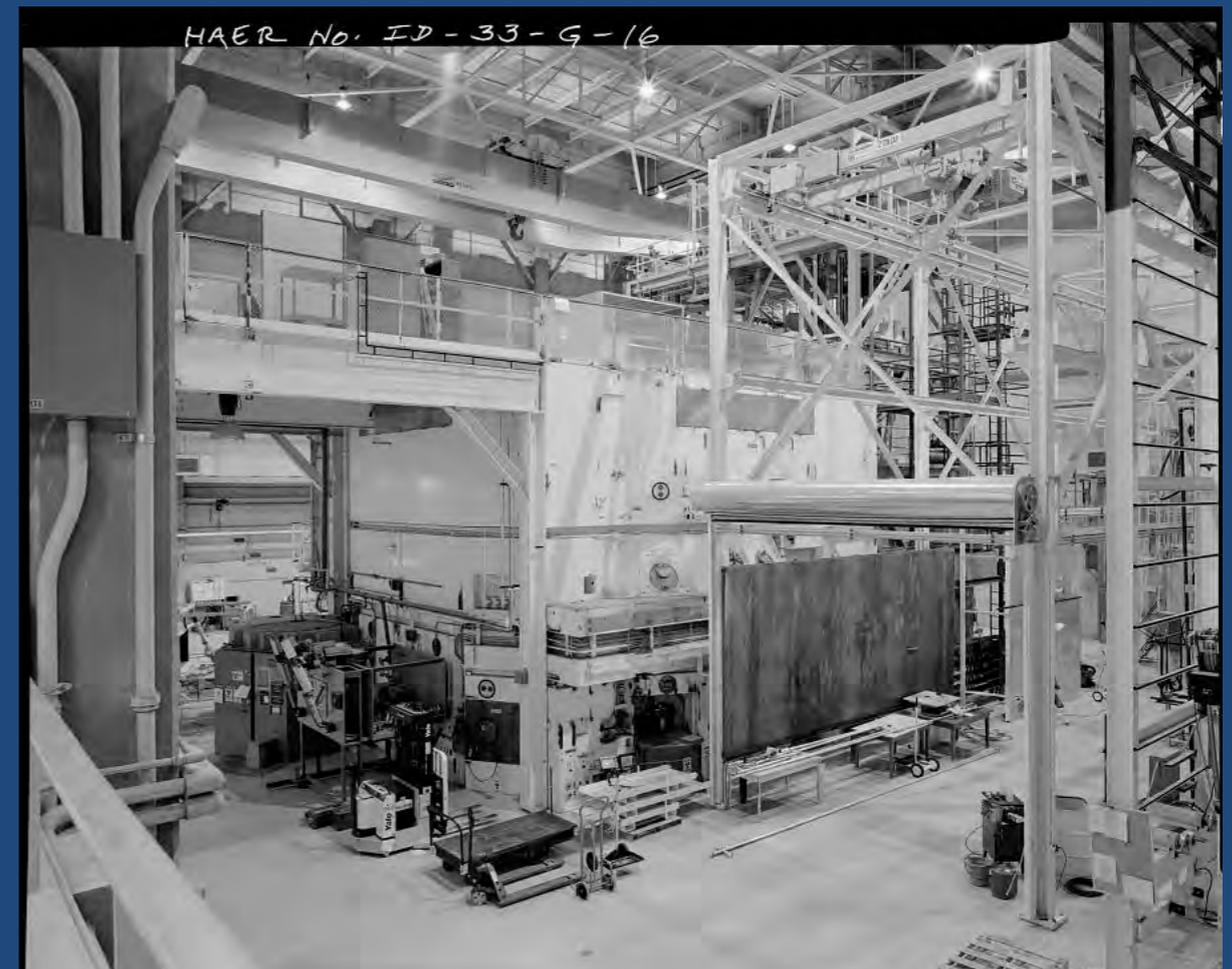
- **Recommend SEC Class from January 1963 through December 1974**
  - **Known alpha contamination in the Analytical Laboratories and processing cells in the 1963 time period. Very few workers monitored for plutonium exposure.**
  - **Potential for routine exposure to transuranic radionuclides during Np-Pu Campaign from 1965 to 1972.**
  - **Degradation of Radiological Control Program beginning around 1963 that resulted in unmonitored plutonium exposures that were detected by chance during a second exposure incident.**

# CPP Recommendation

- Potential for exposure continued past 1970 initial evaluation period through at least the end of 1974 when the review committee published their report.
- NIOSH will continue to evaluate post 1974 years and may expand the class through the 83.14 process.
- Somewhere between 1974 and the 1980s operations improved
  - Improved (increased) routine bioassay (fecal and urine)
  - Significant effort to decontaminate facilities

# Test Reactor Area (TRA)

- **Materials Test Reactor (MTR) 3/52 - 4/70**
  - Engineering Test Reactor Critical Facility 5/57 - 12/81
- **Engineering Test Reactor (ETR) 9/57 - 12/81**
  - Advanced Reactivity Measurement Facility No 1 (ARMF-1) 10/60 - 12/74
  - Advanced Reactivity Measurement Facility No 2 (ARMF-2) 12/62 - 12/68
  - Advanced Test Reactor Critical Facility 5/64 - present
- **Advanced Test Reactor (ATR) 7/67 - present**



# Test Reactor Area – Other Facilities

- Neutron Chopper
  - Neutron cross-section measurements
- Gamma Spectroscopy Lab
  - Operated next to MTR
  - Scintillation Spectroscopy Catalog (*IDO-16880 - Heath*)
- Chemistry Labs
  - Some exotic radionuclide separations
- Gamma Building
  - Co-60 Irradiations
- Alpha Hot Cell (Cave)
  - Operational around 1960

# TRA Chemistry Laboratories

- Over 200 exotic radionuclides have been identified as being produced in MTR and ETR
- Vast majority are beta/gamma emitters
- Some actinides produced and separated in alpha labs



# TRA Recommendation

- Minimal potential for internal alpha exposure (few workers exposed to alpha materials)
- Internal exposures to airborne radionuclides were controlled by smear survey and continuous air sampling
- Plutonium and other actinide bioassay available for these few workers that we have identified as exposed
- Actinide doses to workers at TRA can be reconstructed using individual bioassay.
- Mixed Fission Product doses can be reconstructed, however, a co-worker model is needed for the post 1967 time period

# Whole Body Counting - 1963

PHILLIPS PETROLEUM COMPANY			
ATOMIC ENERGY DIVISION		APPENDIX A	
STANDARD PRACTICE NO.	6.24.1	SUBJECT	MTR-ETR Whole Body Count Frequency Schedule
AREA	Health & Safety Branch	PAGE NO. <u>i</u> of <u>iii</u>	DATE ISSUED <u>4/1/63</u> EXPIRES
APPROVED BY	<i>[Signature]</i>	SUPERSEDES ISSUE DATED	<u>2/25/63</u>
Group	Once/4 Mo.	Once/Year	No Count
<u>MTR HP</u>			
Technicians and Issue Clerk	18		
Supv., Tech., Safety, Nurse		7	1 <sup>a</sup>
<u>ETR HP</u>			
Technicians and Issue Clerk	17	5	
<u>H&amp;S Services</u>			
		1 <sup>b</sup>	3
<u>Instrument Maintenance</u>			
Instrument Technicians	33		
Supervisors		7	
<u>Electrical Maintenance</u>			
Shift Electricians	4		
Day Electricians		11	
Supervisors and Others			11
<u>Machine Shop</u>			
Machinists		8	
Supervisors			2
<u>Hot Cell</u>			
	6		
<u>MTR Chemistry</u>			
Chemists	1 <sup>c</sup>	9	
Supervisors		4	
<u>MTR-ETR Maintenance</u>			
Mechanics	21		
Fitters	16		
Welders	12		
Insulators	2		
Heavy Equipment Operators	4		
Yardmen		9	
Custodian			13
Tool Crib			3
Painter		1	
Carpenter			1
Supervision			
Foremen	9		
Supervisors			9
<u>MTR Operations</u>			
Shift Supervisor		5	
Foremen		4	
Engineers	31		
Operators			
Reactor Service	5		
Process Water	8		
Steam Plant	4	5 <sup>d</sup>	

PHILLIPS PETROLEUM COMPANY			
ATOMIC ENERGY DIVISION		APPENDIX A	
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APPROVED BY	<i>[Signature]</i>	SUPERSEDES ISSUE DATED	<u>2/25/63</u>
Group	Once/4 Mo.	Once/Year	No Count
<u>Demineralizer Building</u>			
	9		
<u>Gamma Building</u>			
	1		
<u>Other Supv., Coords.</u>			
		5	
<u>ETR Operations</u>			
Shift Supervisors		5	
Foremen		4	
Engineers	27		
Operators			
Process	14		
Service	8		
Other Supv., Coords.		7	
<u>Project Engineering</u>			
Engineers	15 <sup>e</sup>	10	
Supervisors			6
Others			1
<u>Plant Engineering</u>			
Radiographers	6		
MTR-ETR Process Eng.		4	
Supervisors and Others			14
<u>Technical</u>			
RMF		8	
ETRC		7	
Reactor Physics Research			10
Radioactivity and Decay			6
Radiation Measurements	1 <sup>f</sup>	8	
<u>Instrument Development</u>			
			60
<u>Nuclear Physics</u>			
			27
<u>Design Engineering</u>			
			31
<u>Secretaries and Clerks</u>			
			60
SUB-TOTAL	272	134	258
Count Frequency	68/mo.	11/mo.	
		<u>79/mo. Total</u>	

# Whole Body Counting - 1967

- Change from exposure potential based frequency to random of ¼ of workforce per year
- Thus a co-worker model is needed to estimate exposure

IDAHO NUCLEAR CORPORATION

STANDARD PROCEDURE NO. 07-4 SUBJECT Whole Body Counting

AREA IN Health and Safety PAGE NO. 1 OF 2 DATE ISSUED 2-6-67 EXPIRES \_\_\_\_\_

APPROVED BY [Signature] BO. MGR. SUPERSEDES/ISSUE \_\_\_\_\_ DATE \_\_\_\_\_

[Signature] Acting Division MGR. [Signature] PROJECT MGR.

1.00 PURPOSE:

To establish the Whole Body counting program which is directed by the IN Health and Safety Branch.

2.00 SCOPE:

This procedure will apply to all IN personnel, long-term visitors, and other individuals working in IN areas who may be specified by the local Health Physics supervisor of that area. The Headquarters building personnel in Idaho Falls are excluded unless they spend long periods in the plant areas and/or are specified by the local HP supervisor. A long-term visitor is anyone assigned to IN controlled areas for a period exceeding 30 days.

3.00 POLICY:

All employees working in IN radiation controlled areas will receive whole body counts based on schedules prepared by the Health Physics supervisors of TRA, CPP, CFA, and TSP.

4.00 PROCEDURE:

4.10 Routine

4.11 The Health Physics supervisor in an IN controlled area will prepare a list of employees. The list will include approximately one-fourth of those in each working group, including long-term visitors. This list for the following year will be submitted to the Health and Safety Branch Manager by the preceding first of December. Each year the list will be changed so that at the end of four years every individual in each IN plant will have been counted at least once. Each individual on these lists will be scheduled and counted at a time convenient to ID Health and Safety. The Health and Safety Records office will prepare copies of the Whole Body count form and forward to ID. These forms will be used when the individual reports to Medical on the yearly blood work or scheduled physical.

4.20 Terminations

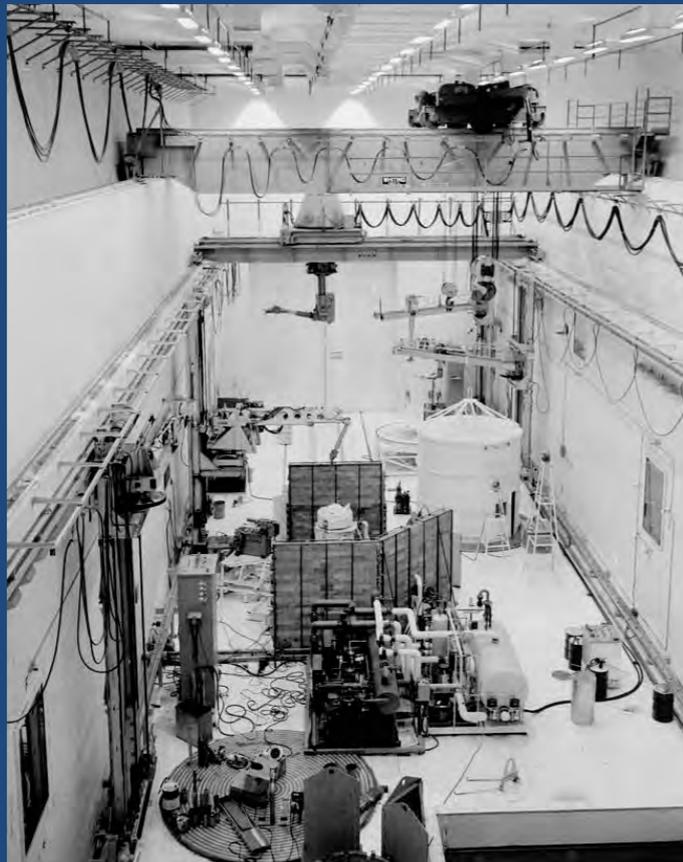
4.21 During the check-out procedure for any terminating employee, the local health physics supervisor will make a decision whether or not the terminating employee will have a whole body count.

# Test Area North (TAN)

- **Initial Engine Test (IET)**
  - Heat Transfer Experiments (55-60)
  - SNAPTRAN (64-66)
- **TAN – Hot Shop (607)**
- **TAN – Actuator Building (615)**
- **Low Power Test Facility (LPT)**
  - Cavity Reactor Critical Experiment (CRCE) (67-70)
  - Critical Experiment Tank (CET) (58-62)
  - Thermal Reactor Idaho Test (THRITS) 1964
- **Shield Test Facility (STF)**
  - Shield Test Pool Facility (Susie) (early 1960s)

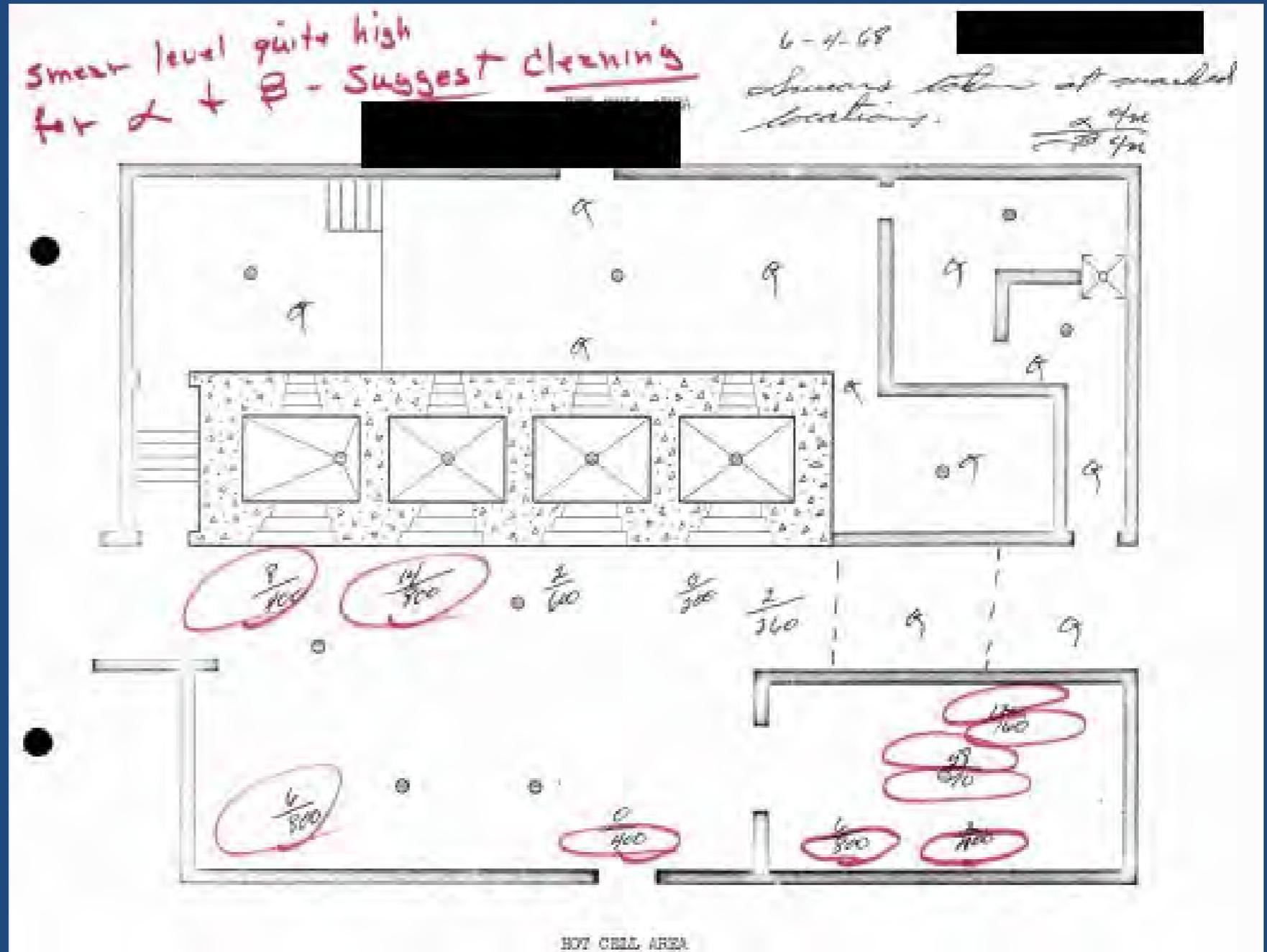
# Test Area North

- Fission product and actinides not separated and appear to always be together



# Test Area North – Hot Cell (633)

All alpha are accompanied with significant beta / gamma readings



# TAN Actuator Building (TAN-615)

- Actuator building was built in 1956 for testing prototype control mechanisms (control rods) for Initial engine Tests (IET).
- Sometime after 1961 was renamed to the TAN Fuel Handling Facility.
- In 1963 during turnover to Phillips Petroleum Company building was found to be contaminated with uranium.
- Reserved judgment on this facility until we can evaluate further.

# TAN Recommendation

- No appreciable exposure to actinides without mixed fission products.
- Actinide exposures can be bounded using a ratio to mixed fission product bioassay.
- Given the decrease in urinalysis and whole body count data in 1967-1970, we recommend development of a co-worker model for mixed fission products.
- NIOSH will prepare an addendum to Evaluation Report SEC00219 for the actuator building from 1961-1970.

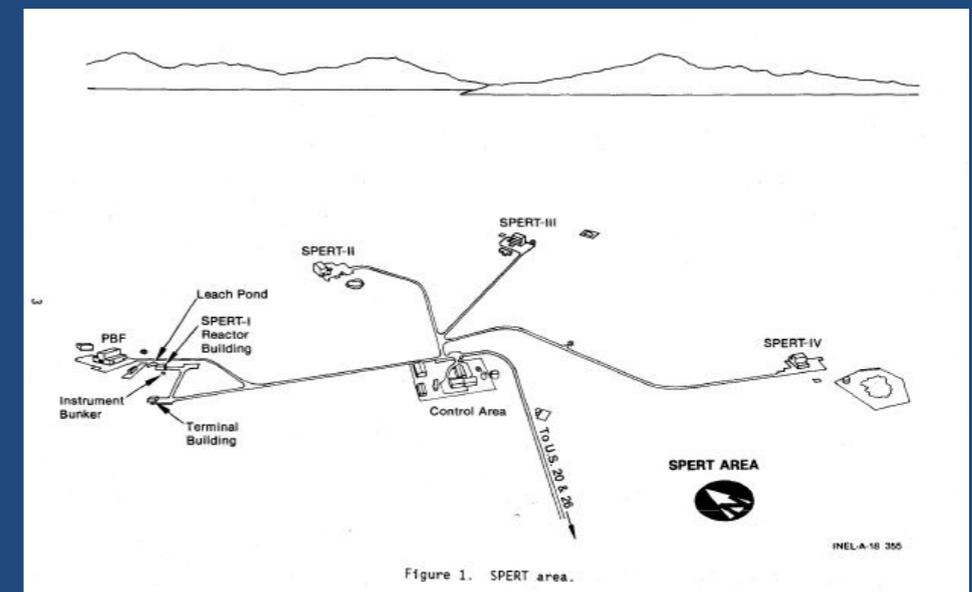
# Misc. Reactor Areas

- **Special Power Excursion Reactor Tests (SPERT)**
  - SPERT-1 (55-64)
  - SPERT-2 (60-64)
  - SPERT-3 (58-68)
  - SPERT-4 (62-70)
- **Auxiliary Reactor Area (ARA)**
  - ARA-1 (Hot Cell) (built in 1957)
  - ARA-2 (Stationary Low Power , SL-1) (58-61)
  - ARA-3 Gas Cooled Reactor Experiment (GCRE) (60-61)
  - ARA-4 (Mobile Low Power , ML-1) (61-64)
- **Organic Moderated Reactor Experiment (OMRE) (57-63)**

# Special Power Excursion Tests

## SPERT I - IV

- Investigate the safety of water cooled reactors
- Central Control point
- Personnel evacuated from area during operation
- CAMs on facility exhausts.
- Health Physics involved in re-entry and small workforce was monitored



# ARA Recommendation

- **SPERT – Dose Reconstruction is feasible since the exposure is limited to mixed fission products and workers were monitored**
- **ARA II through IV –Dose Reconstruction is feasible since exposure is limited to mixed fission products**
- **OMRE – Dose Reconstruction is feasible since exposure is limited to mixed fission products**
- **ARA-I – Dose reconstruction is feasible with the possible exception of the 1968 Pa-233 work therefore 1968 is reserved.**

# Central Facilities - Laundry (CF-669)

- Clothing segregated by type and contamination level
- After cleaned and dried was monitored on special tables
  - Each type had permissible contamination levels
  - Any item over limit was rewashed
  - After 30 to 90 day decay if Anti-C could not be decontaminated it was returned to facility for disposal
- Laundry had a radiation detector above receiving room door and a CAM in working area
- Room was evacuated if either alarmed

# Burial Ground

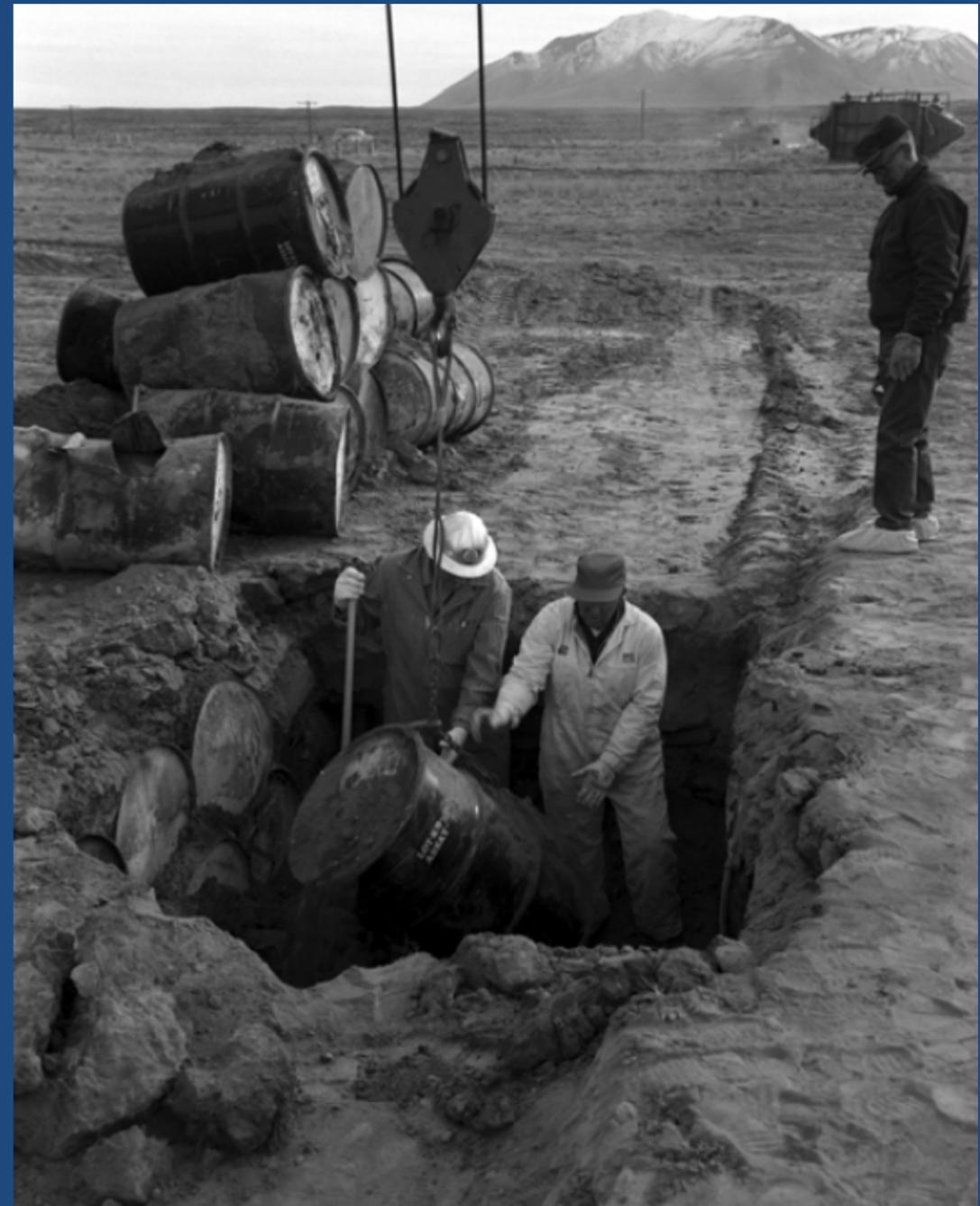
- July 1952 – First Trench dug
- April 1954 – First shipment of Rocky Flats Waste
- 1957 First description of twice weekly pick-ups
- 1957 First Burial Pit due to bulk items from Rocky Flats
- 1958 Rocky Flats drums stacked by hand
- 1961 Rocky Flats drums stacked using crane
- 1963 Rocky Flats waste no longer stacked dumped
- 1969 First retrieval of Pu drums from Rocky Flats
- 1970 Burial of Pu waste discontinued

# Burial Ground Monitoring

- **Restricted access (Locked Gate)**
- **1959 memo indicates workers required to**
  - **Wear film badge at burial ground issued by Central Facilities**
  - **Wear anti-contamination clothing (PPE)**
  - **Work under a Safe Work Permit (SWP)**
  - **Workers were monitored by Health Physics before leaving**
- **Health Physics was always present during dumping**
- **Air Sampling during drum dumping of Rocky Flats waste**
- **Radiological Surveys of Burial Ground**

# Burial Ground – Drum Retrieval

- Concern with initial drum retrieval.
- First effort was small – dozen or so drums for a few days.
- In 1971 larger effort was conducted.
- Buildings were erected and continuous worker presence.
- Need to further evaluate post 1968 period.



Drum Retrieval from Pit 1 in 1969

# Burial Ground - Recommendation

- Doses can be reconstructed for the period 1953 through 1968.
- NIOSH is uncertain about the 1969 Initial Drum Retrieval (IDR) and later operations through the 1980s.
- Reserving post 1968 period (1969 - ????)
- NIOSH will prepare an addendum to Evaluation Report SEC00219 for 1969-1970.
- NIOSH will evaluate post 1970 years and may expand the class through the 83.14 process.

# Feasibility Summary

	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75												
TRA				Dark Green													Light Green																						
CPP					Dark Green								Red																										
TAN								Dark Green				Yellow																											
ARA								Dark Green																															
CFA	Dark Green													Light Green																									
BG				Dark Green													Light Green		Yellow																				

- Can use area dosimeter badges to place workers at CPP during the 1963 to 1974 timeframe and therefore define the class.
- Light shaded green indicates the need for area specific co-worker model due to reduction in whole body counting.

# Feasibility Summary

**Table 7-18: Summary of Feasibility Findings for SEC-00219**

January 1, 1963 through December 31, 1974 (Chemical Processing Plant);

January 1, 1949 through December 31, 1970 (INL site excluding CPP SEC class and reserved areas)

Source of Exposure	<u>Chemical Processing Plant</u> Jan. 1, 1963 through Dec. 31, 1974		<u>INL Site Excluding CPP SEC</u> <u>Class and Reserved Areas</u> Jan. 1, 1949 through Dec. 31, 1970	
	Reconstruction Feasible	Reconstruction Not Feasible	Reconstruction Feasible	Reconstruction Not Feasible
<b>Internal</b>		<b>X</b>	<b>X</b>	
- Uranium (U)		X	X	
- Neptunium (Np)		X	X	
- Plutonium (Pu)		X	X	
- Thorium (Th)		X	X	
- Transuranic Radionuclides		X	X	
- Fission products (MFP)	X		X	
- Noble gases (Kr, Xe)	X		X	
- Iodine (I)	X		X	
- Tritium (H3)	X		X	
<b>External</b>	<b>X</b>		<b>X</b>	
- Gamma	X		X	
- Beta	X		X	
- Neutron	X		X	
- Occupational Medical X-ray	X		X	

# INL SEC Petition 00219—cont.

- **Health Endangerment**
  - Some workers in the class may have accumulated chronic radiation exposures through intakes of radionuclides at CPP.
  - NIOSH is specifying that health may have been endangered for those workers monitored at CPP who were employed for a number of work days aggregating at least 250 work days.
- **What about employees not included in the SEC?**
  - NIOSH intends to use monitoring data to conduct partial dose reconstructions for individuals not part of the SEC

# Proposed Class

*All employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the Idaho National Laboratory in Scoville, Idaho, and were monitored for external radiation at the Idaho Chemical Processing Plant (CPP) (e.g., at least one film badge or TLD dosimeter from CPP) between January 1, 1963 and December 31, 1974 for a number of work days aggregating at least 250 work days, occurring either solely under this employment, or in combination with work days within the parameters established for one or more other classes of employees in the Special Exposure Cohort.*