



U.S. DEPARTMENT OF  
**ENERGY**

ARF-022415



# F-Area Material Storage Building (235-F) Information Meeting

*ERD-EN-2019-0045*

*October 30, 2019*



# Agenda

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- **Purpose/Introduction**
  - Summary from March 6, 2019 meeting
  - Status of CAB Recommendation #364
- **Building 235-F Status/Update**
  - Building 235-F History
  - Radioassay Results/Inventory
  - Planned Deactivation Activities (FY20-FY22)
- **Building 235-F End State**
  - Proposed Alternatives
  - Fate & Transport Modeling Results
- **Preliminary Human Health Risk Summary**
- **Regulatory Path Forward**
  - D&D Planning
  - RSER/EE/CA Development

## Purpose/Introduction

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- **Summary from March 6, 2019 Meeting**

- Plutonium-238 (Pu-238) inventory reduction was in progress
- Potential for accelerated decommissioning (vs. long term safe storage) was under consideration by Office of Environmental Management (EM)
- DOE beginning process of achieving consensus on an “acceptable condition to end risk reduction (radiological holdup removal) and begin decommissioning, either immediately or later”
- Identified CERCLA decommissioning model as appropriate; discussed Remedial Action vs Removal Action process and agreed to Non-Time Critical Removal Action
- Acceptable end state (including residual material) and point of assessment still to be decided
- Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis (RSER/EE/CA) must include the following:
  - *Describe condition of facility at the end of deactivation (rad inventory, waste form, risk)*
  - *Propose and describe reasonable range of end state alternatives (No Action, In Situ, D&R)*
  - *Describe selected end state and show protectiveness (including GW modeled impact)*

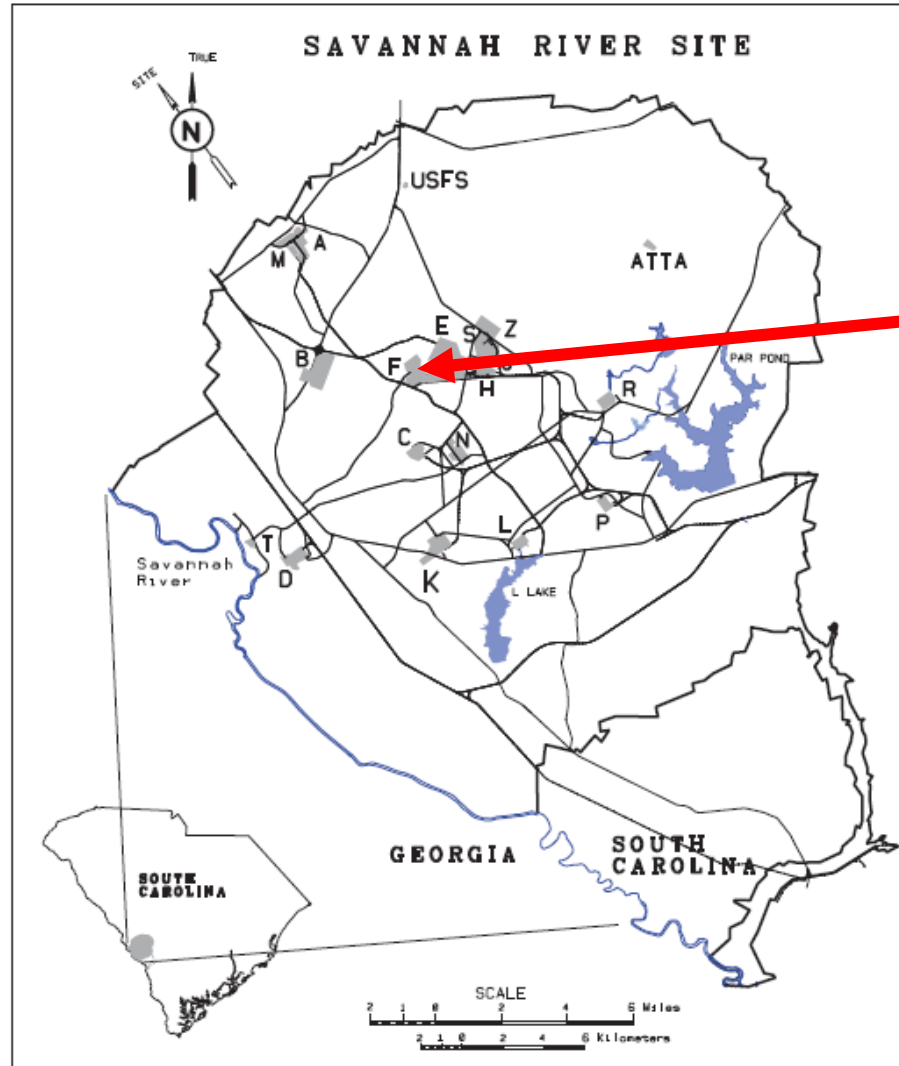
## Citizen Advisory Board (CAB) Recommendation

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### CAB Recommendation #364, Accelerated D&D of 235-F (May 14, 2019):

1. *Accelerate the timeline for decommissioning 235-F with a targeted completion date of 2026.*
2. *Initiate the preparation of required regulatory documents in parallel with the deactivation process.*
  - a. *These documents may include the preparation of an Engineering Evaluation Cost Analysis (EECA), Remedial Investigations (RI) for Remedial Actions (RA), Interim ROD Feasibility Studies (FS) for decommissioning design, Interim ROD, Start Decommissioning Implementation plans, and budgets.*
  - b. *Parallel preparation of the required regulatory documentation will help complete the decommissioning of the facility a number of years ahead of the proposed FFA schedule and offer what is considered the most cost-effective option.*

# Building 235-F Location



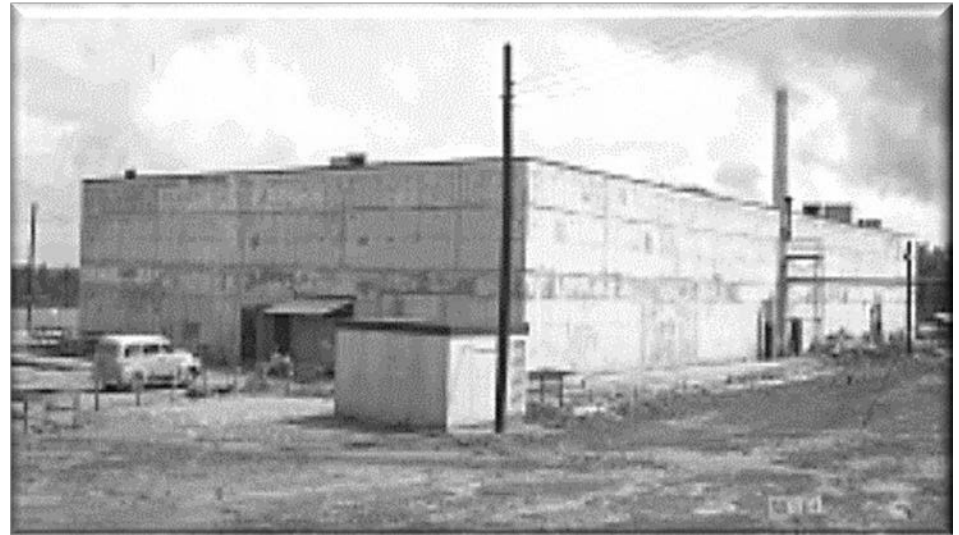
F-Area

# F-Area Aerial Photo



## Building 235-F Description

- Blast-resistant, windowless, two-story, reinforced concrete structure
- ~220' long, ~110' wide, and 28' high
- Footprint of ~24,000 ft<sup>2</sup>
- Exterior walls – 14" inches thick
- Roof and 2<sup>nd</sup> floor – 8" thick
- Nearby facilities include:
  - 294-2F Sandfilter (A)
  - 292-2F Fanhouse (B)
  - 281-28F Spill Basin (C)
  - 235-1F/2F Refrigeration Buildings (D)
  - Trailers 235-11F & 245-6F (E)
  - 701-4F Gatehouse Entrance (F)
  - 720-F Central Alarm Station (G)



## Building 235-F History

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- Part of the original construction at SRS in the early 1950s
- Original mission was “C-Line”
  - Cancelled before any equipment installed
- First mission was the Special Products Fabrication Facility (SPFF)
  - Supported programs processing Uranium-238 (U-238), Neptunium-237 (Np-237) and Plutonium-239 (Pu-239) oxides
- Next mission was the **Plutonium Experimental Facility (PEF)** and the **Plutonium Fuel Form (PuFF) Facility** including the **Old Metallography Laboratory (OML)**
  - Produced Pu-238 oxide spheres/pellets for Radioisotope Thermoelectric Generators (RTGs)
  - SPFF decontaminated/truncated to **Actinide Billet Line (ABL)** to make way for the PuFF Facility
  - ABL produced special billets containing Np-237 oxide for irradiation in SRS reactors
- All processes (in red) were shut down by 1990; radiological “holdup” remained
- Final mission was receipt, storage and disbursement of plutonium-bearing materials in support of SRS and the DOE complex
  - Emptied storage vaults in 2006 and placed building placed in surveillance & maintenance mode
- “Risk Reduction” Project was active from 2012 to present

# Risk Reduction Project

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- On May 9, 2012 the Defense Nuclear Facility Safety Board (DNFSB) issued Recommendation 2012-1 to address Pu-238 holdup in Building 235-F
- **Issue:** In a seismically-induced, full-facility fire accident scenario the calculated unmitigated dose is about 11,900 rem to the co-located worker (personnel within 100 meters)
- **Desired end point:** Reduce the risk by removing or immobilizing Pu-238 holdup from the PuFF Facility to lower total facility risk to a point within DOE standards (NOT final building disposition)
- **Strategy:** Detailed project plan, hand-picked team, measure progress, learn and adjust
- **Conclusion:** The project was successful in removing the Pu-238 holdup that could reasonably be removed from Cells 1 and 2. Based on the knowledge gained during holdup removal, the accident analysis will be revised along with limiting how a fire can impact the holdup. Based on this information, the Risk Reduction Project accomplished the desired end point.

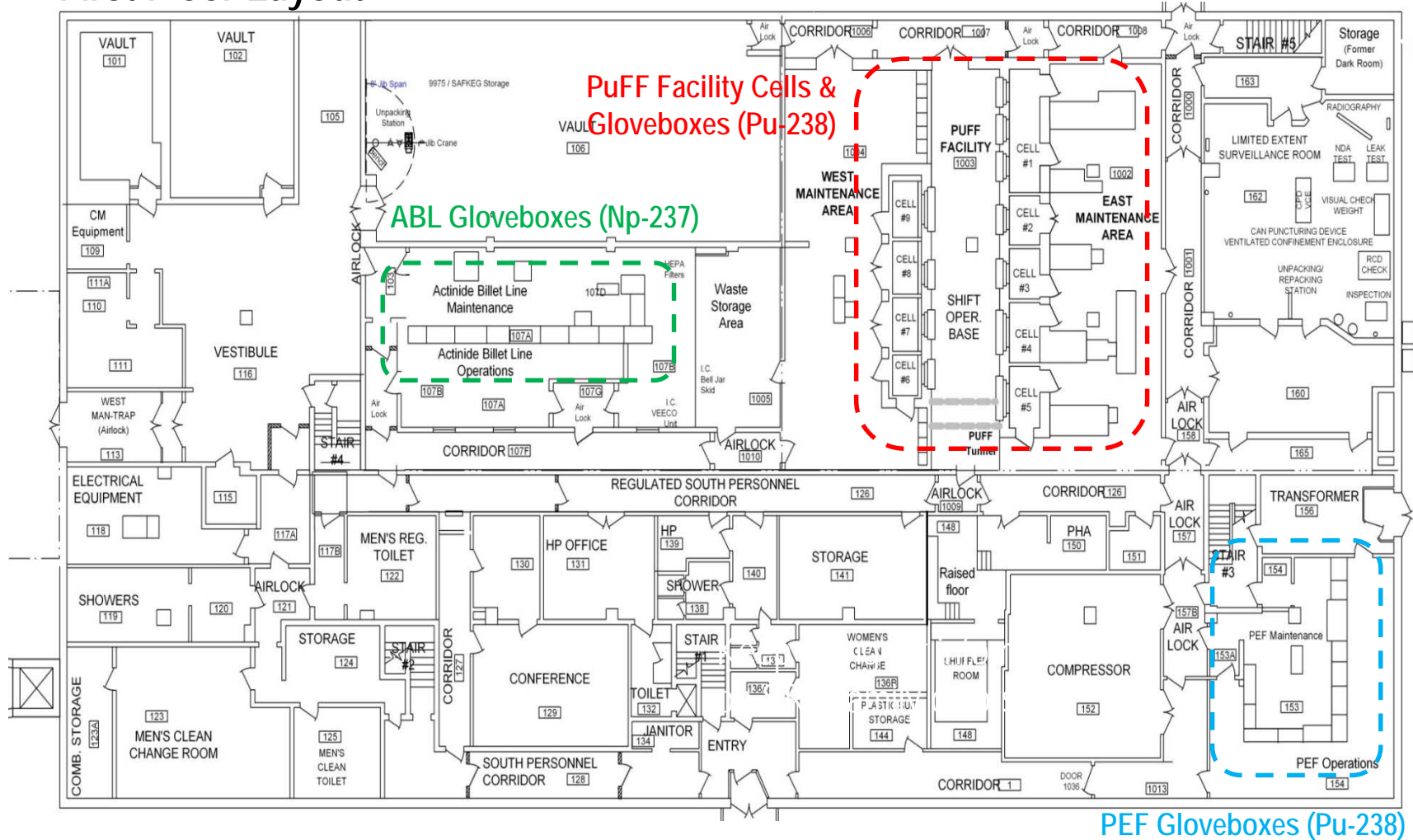
## Risk Reduction Project (Con't.)

- Prepared the facility for Pu-238 holdup removal
- Removed approximately 100 grams of Pu-238
- Demobilization of the Risk Reduction Project is ongoing



# General Arrangement – Building 235-F

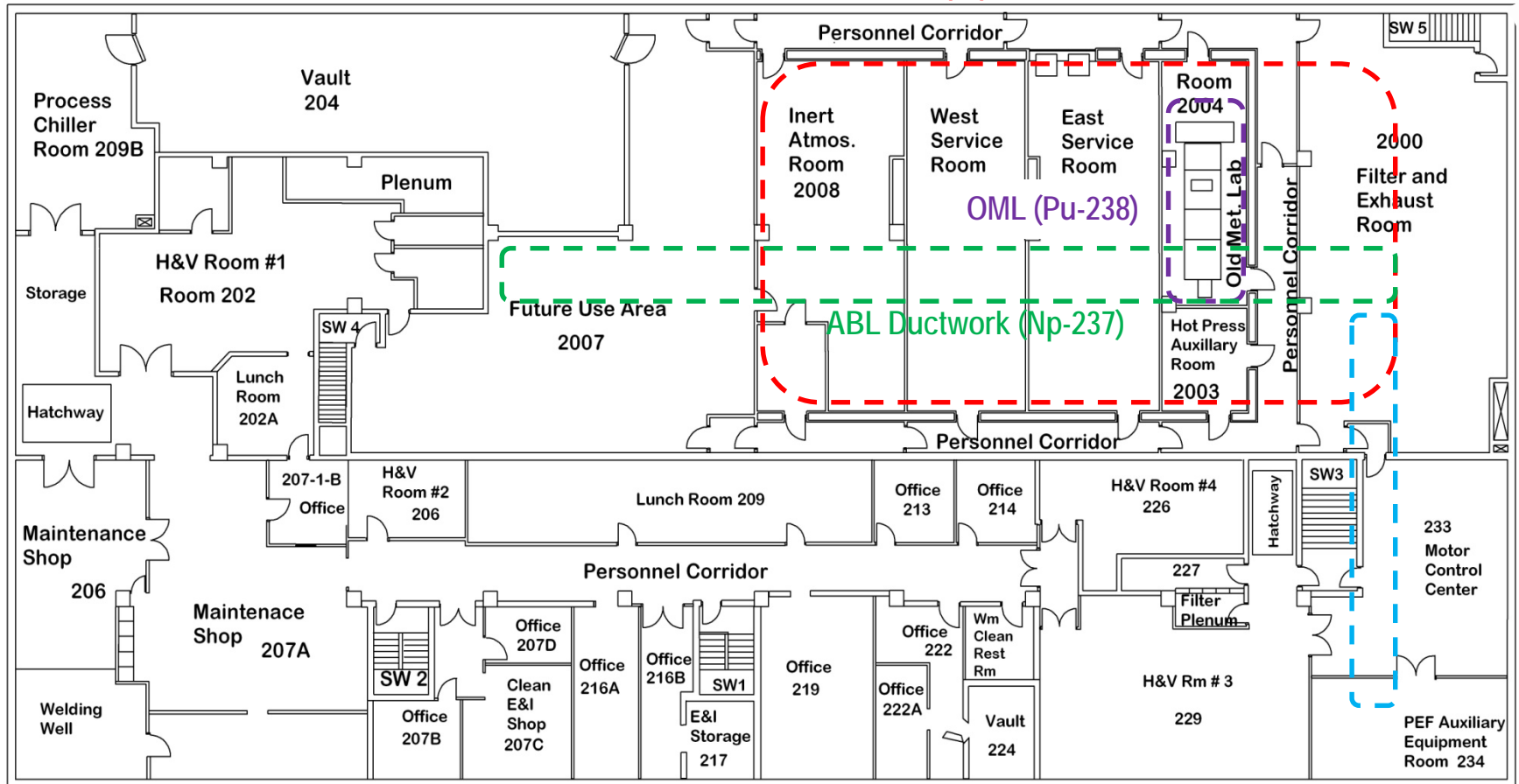
## First Floor Layout



# General Arrangement – Building 235-F

## Second Floor Layout

PuFF Facility Ductwork  
and Equipment (Pu-238)



PEF Ductwork (Pu-238)

# PuFF Facility Photos



Cells 6-9, Room 1003

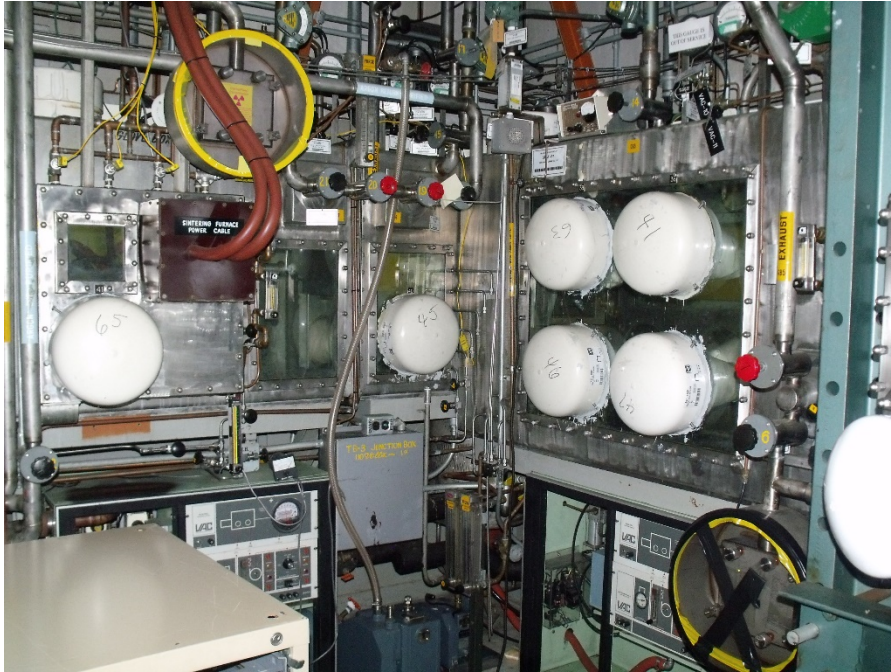


Maintenance GB, Room 1002

Cell 2, Room 1002



# PEF Photos



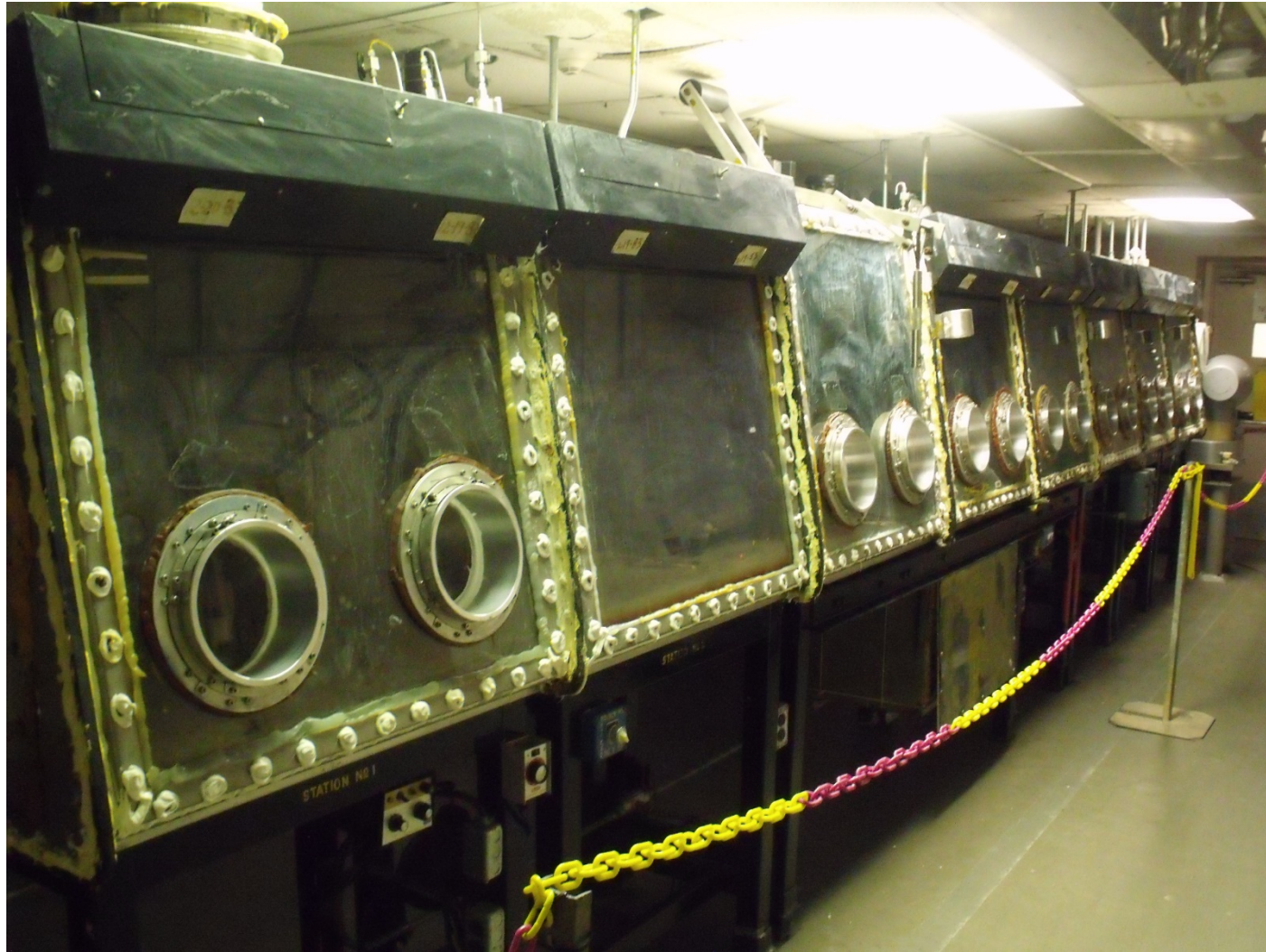
Gloveboxes 5-7, Room 153 (Maintenance Side)



Gloveboxes 3-6, Room 154 (Operating Side)



# OML Photo



# Contaminated Ductwork and Equipment Photos



HEPA Filter Banks, Room 2000



PEF Exhaust Duct, Room 234



Contaminated Equipment (Piping), Room 2010

## Building 235-F Non-Radiological Inventory

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- **Other (non-radiological) contaminants in Building 235-F**
  - PCB paints
  - Lead-based paints
  - Lead shielding and lead counterweights
  - Non-friable asbestos
  - Chilled water with chemical additives for corrosion/algae control
  - Used oils
- **Final inventory TBD, impacted by planned deactivation**

## Building 235-F Path Forward

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- Prepare Building 235-F for Long Term Safe Storage via deactivation project
- Deactivation project to start FY 20 and complete FY22
- Deactivation project activities include:
  - Reconfigure/shutdown ventilation in Building 235-F (fans in 292-2F remain in operation)
  - Isolate all utilities/services to Building 235-F (water, steam, power, etc.)
  - Provide new air compressors and heating to Building 292-2F
  - Complete characterization of Building 235-F by performing assays in all areas containing holdup
  - Remove hazardous materials
  - Fill below grade spaces with grout
    - *Maintenance trench below PuFF Facility cells*
    - *281-28F spill basin*
    - *Waste tank pit*
- Further inventory removal is not planned during deactivation
- Explore options & regulatory process for decommissioning Building 235-F

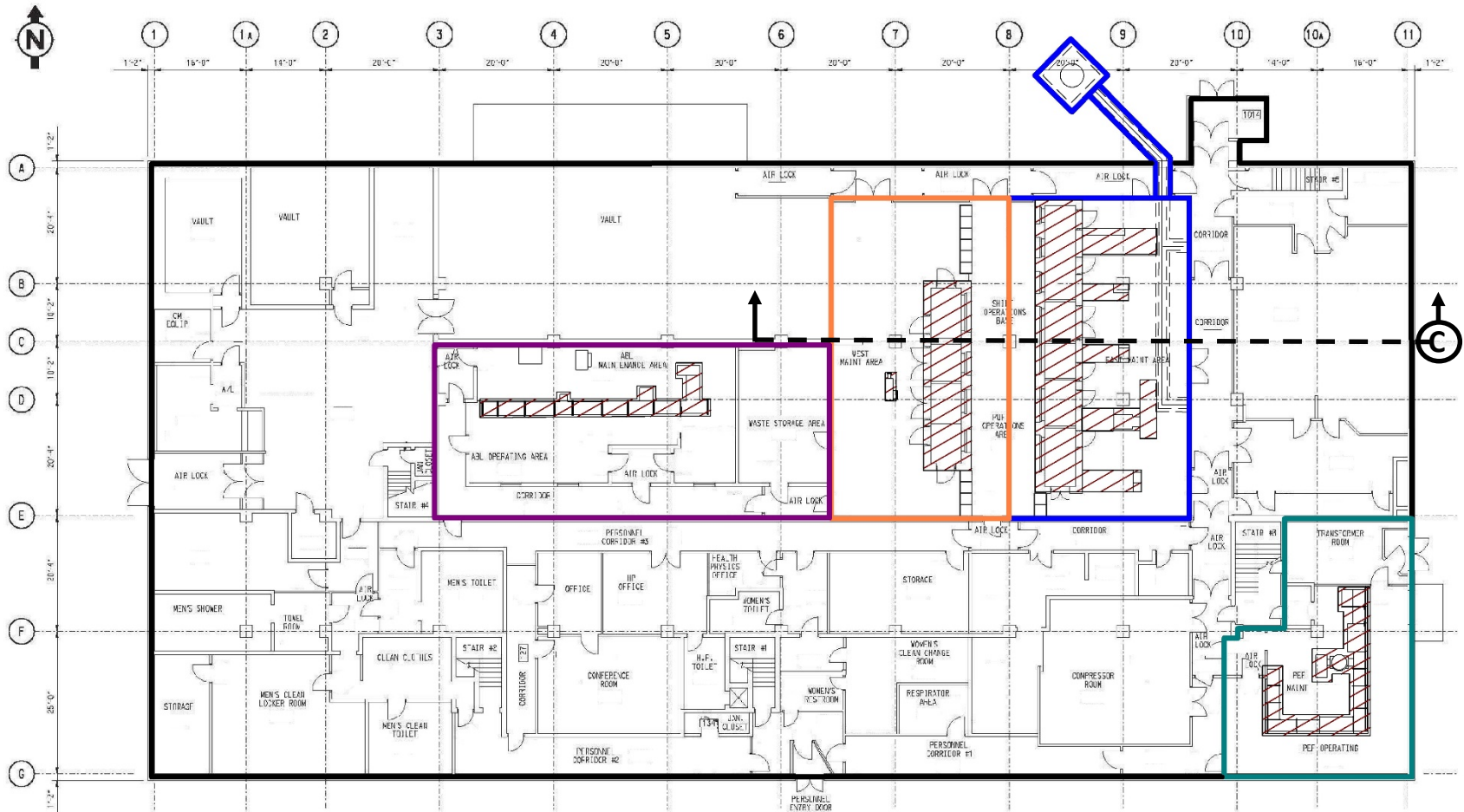
## Evaluated End States for Building 235-F

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Four alternatives were assessed with Fate and Transport (F&T) modeling. Modeling considered a “No Action” alternative as compared to *in situ decommissioning* (ISD) alternatives that contained additional cementitious barriers to further reduce and/or delay the release of radioactive constituents from the Building 235-F into the local environment:

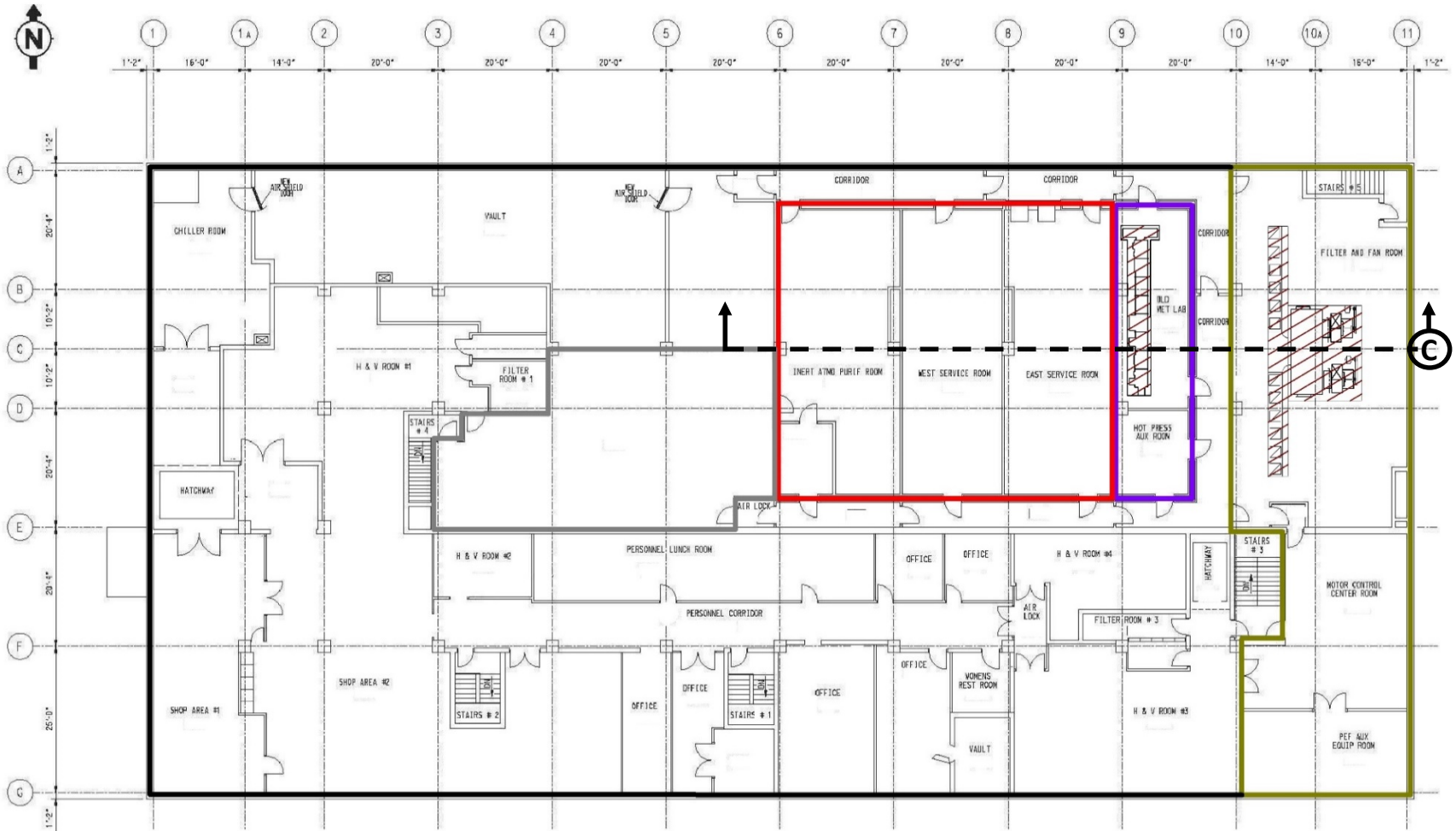
- **No Action** – Facility as it currently exists
- **Grout First Floor** – Entire first floor is grouted (inventory from second floor moved to first floor)
- **Grout Entire Building 235-F** – Entire first and second floors are grouted
- **Grout Entire Building 235-F with Cap** – Entire first and second floors are grouted and a sloped reinforced concrete cap is placed over Building 235-F roof

# First Floor Areas Containing Remaining Radiological Inventory



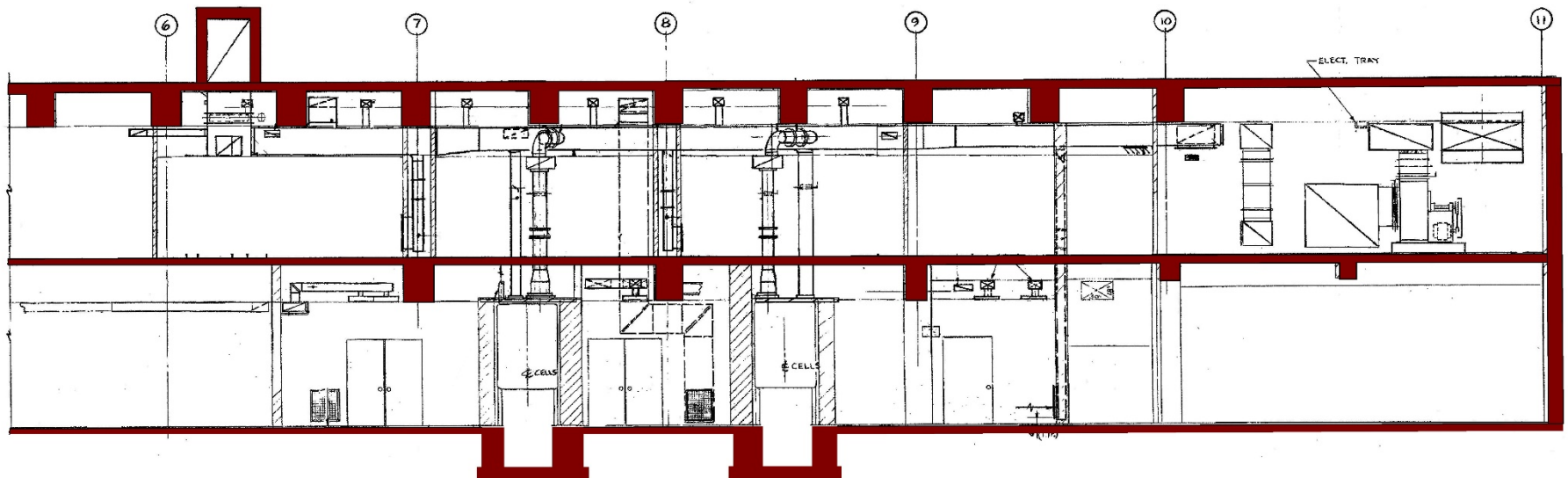
FIRST FLOOR ROOM PLAN

# Second Floor Areas Containing Remaining Radiological Inventory

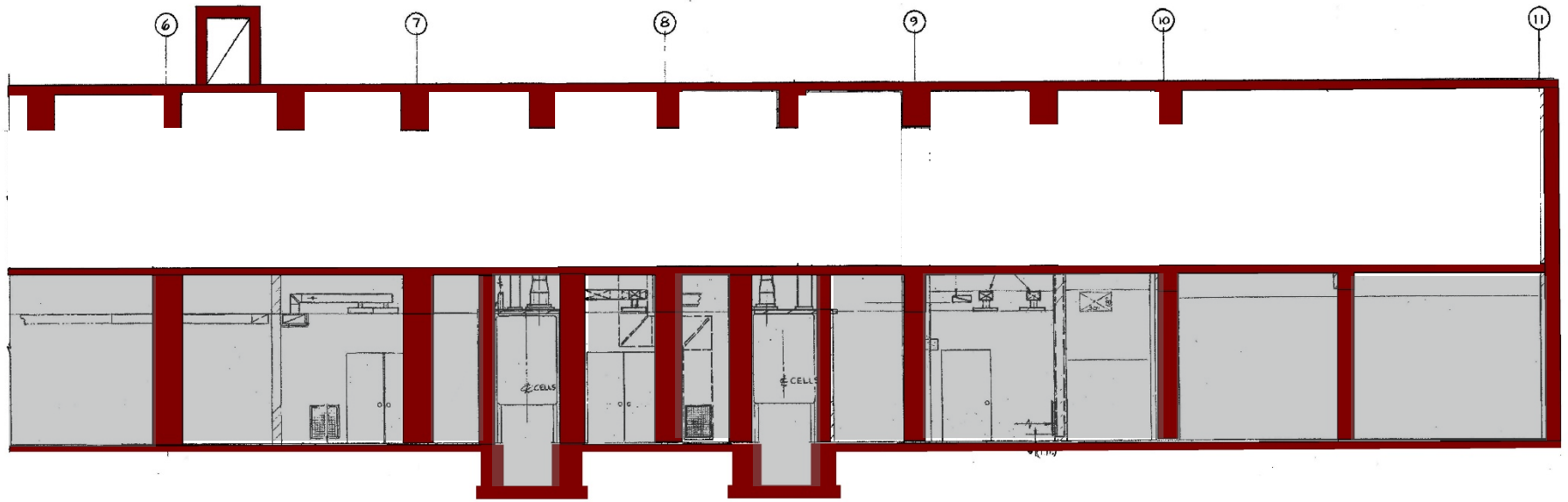


SECOND FLOOR ROOM PLAN

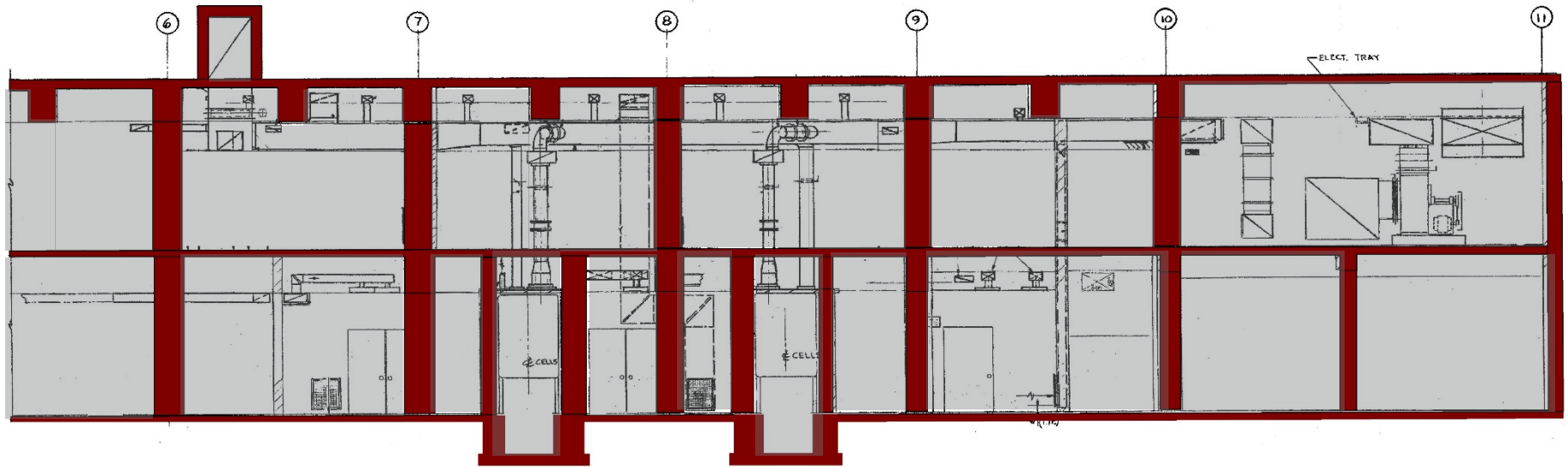
# No Action Alternative (Conceptual)



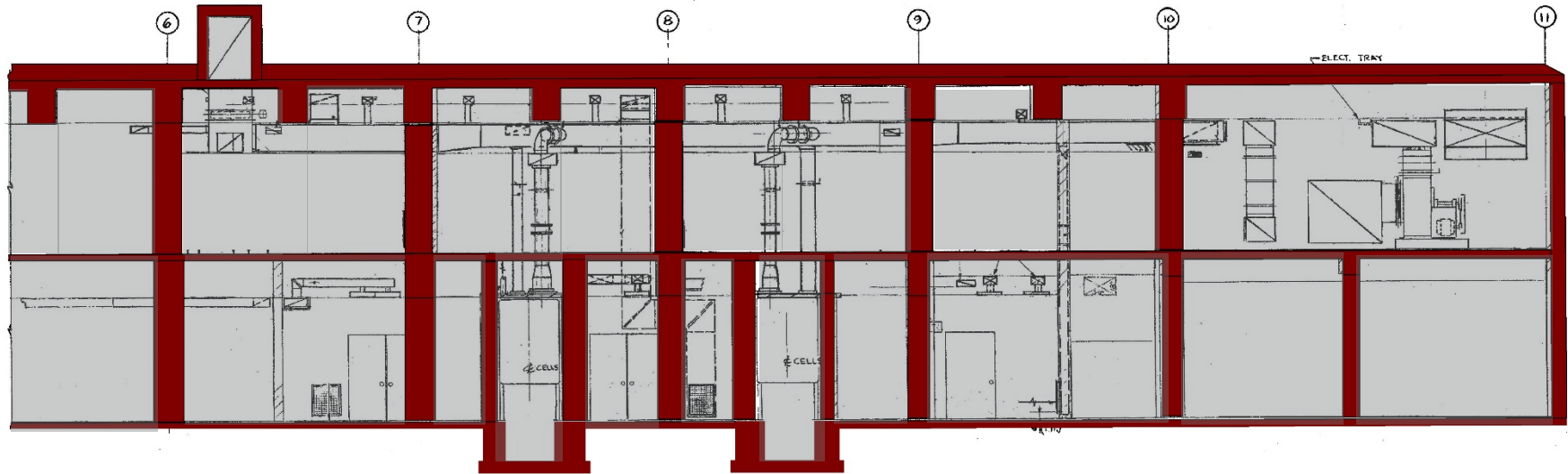
# Grout First Floor Alternative (Conceptual)



# Grout Entire Building 235-F Alternative (Conceptual)

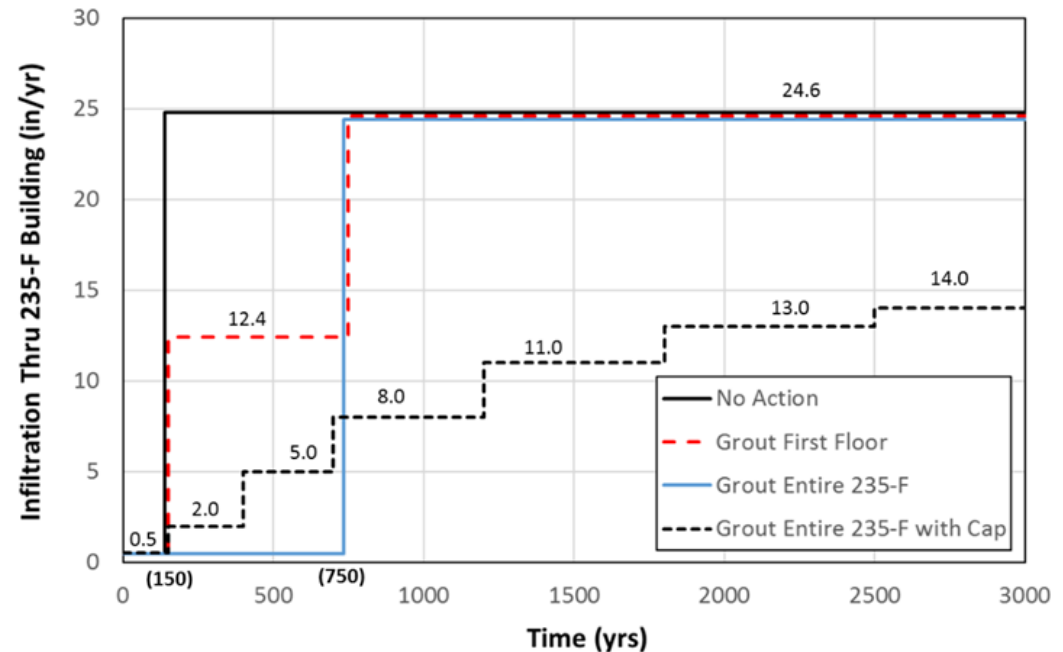
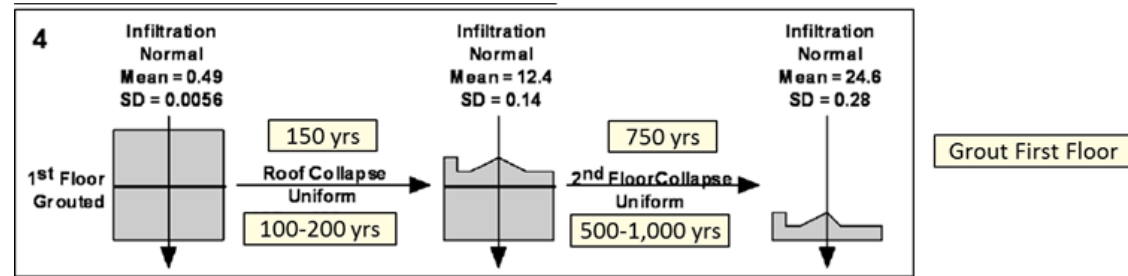


# Grout Entire Building 235-F with Cap Alternative (Conceptual)



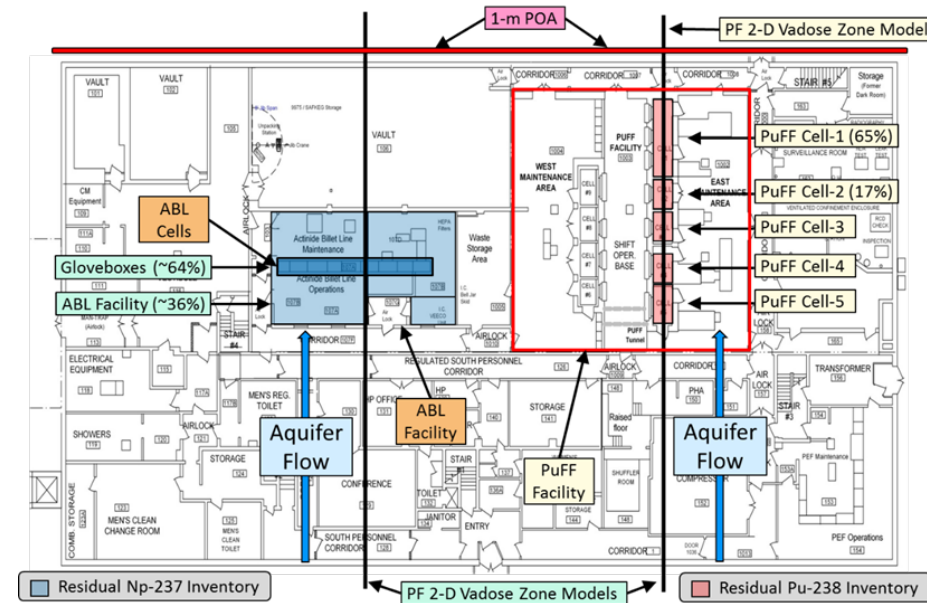
# F&T Modeling Alternatives - Roof Stability and Concrete Degradation

- Four alternatives for building final end state
  - No action
  - Grout first floor
  - Grout all (first & second) floors
  - Grout all and install sloped cap
- Grouting primarily affects infiltration rate over time
- Grout/cement breaks down with infiltration
  - Sorption coefficients and material mass decrease as material is exposed to water



# F&T Modeling - Inventory Allocation and Characteristics

- To be conservative:
  - All Np-237 in ABL
  - All Pu in PuFF cells 1-5
- Building 235-F sources need to be handled differently than reactors since ABL and PuFF are close to facility edge
- Radionuclides modeled as most mobile oxidation state (i.e. Np V vs Np IV) – implicitly through sorption coefficients and solubilities
- Source zone one inch thick (conservative)
- Radionuclides with half life over one year **directly modeled**, others assumed to be in secular equilibrium with parent



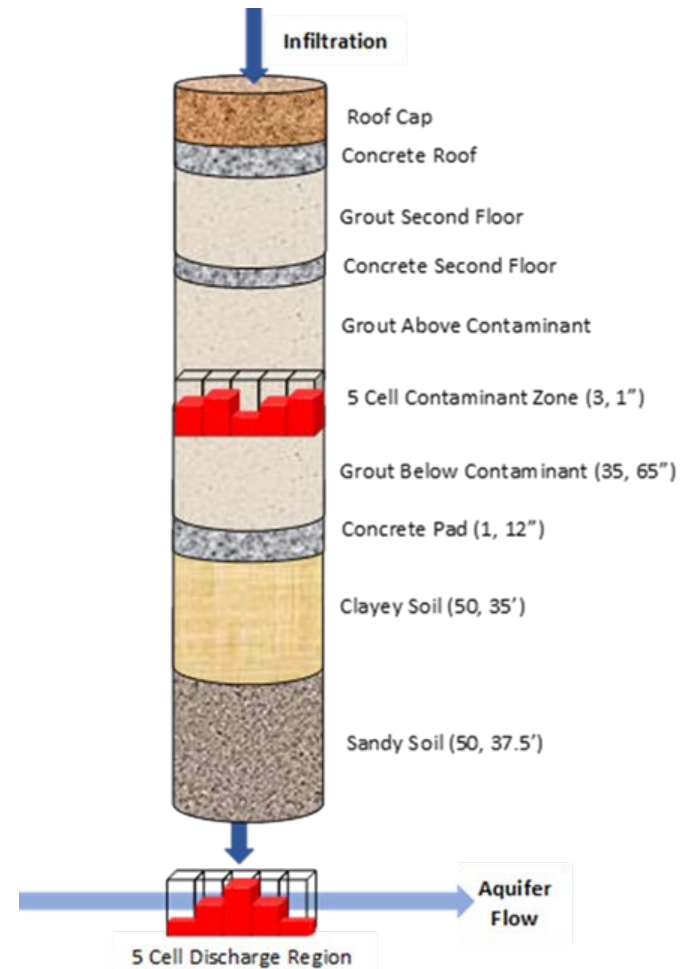
Np-237\* → Pa-233 → U-233 → Th-229

Pu-238 → U-234\* → Th-230 → Ra-226\*

\*main exceedance drivers

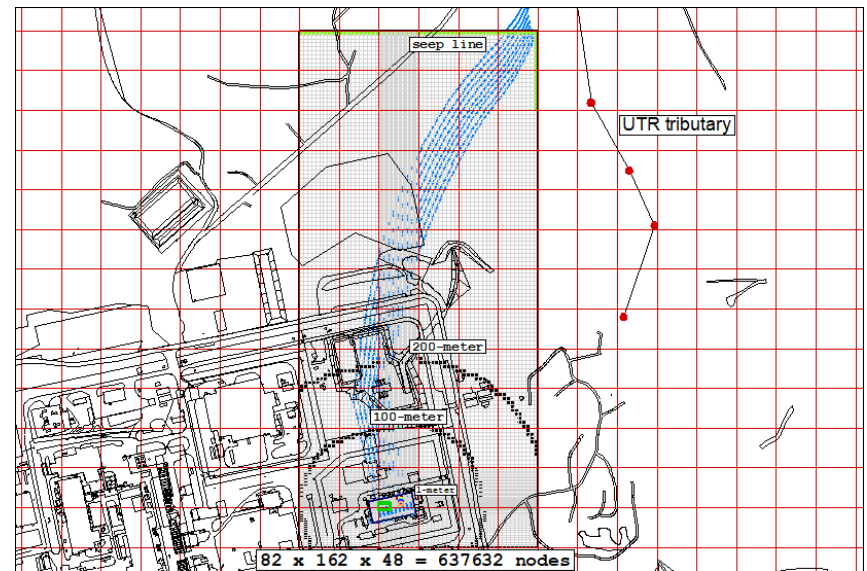
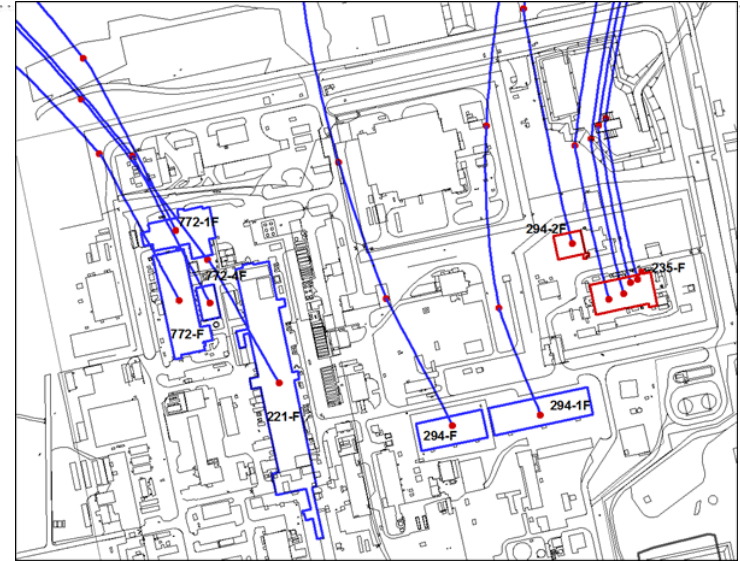
## F&T Modeling - Structure and Vadose Zone Flow

- Flow above the source zone is implicitly modeling by changing infiltration rate into the source zone over time
- Vertical flow transports contamination to the aquifer
- Horizontal flow is not considered until the aquifer is reached



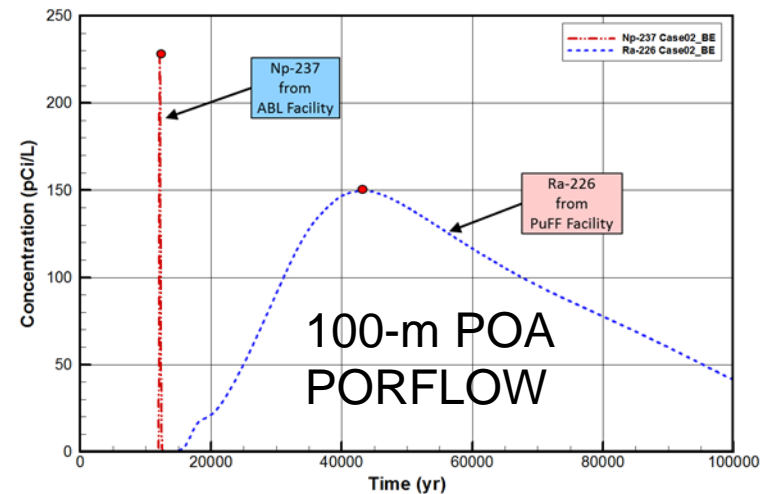
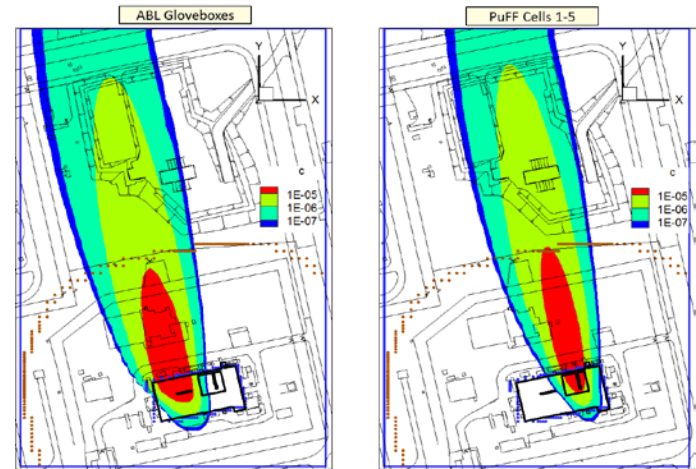
# F&T Modeling - F Area Points of Assessment and Capitalizing on Previous Work

- Four points of assessment (POA) were chosen:
  - 1 m from facility
  - 100 m from facility (for reference F Area boundary is ~360 m)
  - Seep line at unnamed UTR tributary - plume daylight (683 m from facility)
  - Surface water in UTR tributary
- Extensive F Area model previously developed in PORFLOW
  - Used for plume path tracking
  - Demonstrated that the Building 235-F plume is spatially separate from other facilities in F Area and these only combine in UTR
  - Software is not able to perform Monte Carlo simulations to obtain the statistics needed to account for uncertainty in the long time periods modeled



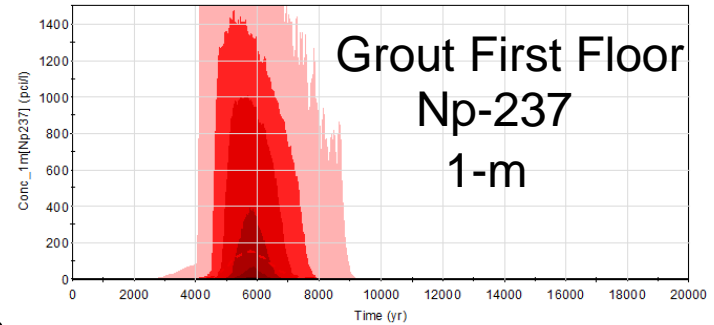
# F&T Modeling - Peak Separation and Calibration

- PORFLOW modeling revealed that releases from ABL and PuFF will have separate peaks due to spatial and temporal separation
- Goldsim model was calibrated using PORFLOW results
  - Flux to groundwater generally matched
  - Calibration improved aquifer dimensions (length and plume dispersion)
  - After calibration models agreed within 10% of each other in deterministic runs
  - An accurate and robust Goldsim model could then be used to account for uncertainties through stochastic modeling (10,000 realizations)



# F&T Modeling – ABL Results

- Exceedances of the gross alpha and beta gamma dose maximum concentration limits (MCLs)
- Driven strictly by Np-237 with Protactinium-233 (Pa-233) in secular equilibrium
- Exceedances seen for all scenarios before 10,000 years except grout and cap

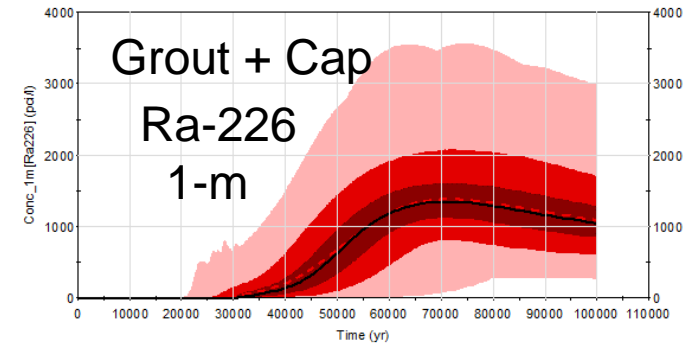


Np-237		Gross Alpha (15 pCi/L)			Beta-Gamma (4 mrem/yr)			Peak Time (years)
		15	15	15	4	4	4	
ISD Alternative	POA (m)	0-1k	Alpha 0-10k	0-100k	Beta-Gamma			Alpha
					0-1k	0-10k	0-100k	
No action	1	31	542	542	0	7	7	1340
	100	2	109	109	0	1	1	1410
	Seep*	0	9	9	0	0	0	
	UTR Trib	0	0	0	0	0	0	1510
Grout first floor	1	0	151	151	0	2	2	5720
	100	0	31	31	0	0	0	5790
	Seep*	0	3	3	0	0	0	
	UTR Trib	0	0	0	0	0	0	5890
Grout entire 235-F	1	0	20	41	0	0	1	12740
	100	0	4	8	0	0	0	12800
	Seep*	0	0	1	0	0	0	
	UTR Trib	0	0	0	0	0	0	12890
Grout entire 235-F with cap	1	0	1	23	0	0	0	21760
	100	0	0	5	0	0	0	21830
	Seep*	0	0	0	0	0	0	
	UTR Trib	0	0	0	0	0	0	21930

\*Concentrations from figures (others exported from model)

# F&T Modeling – PuFF Results

- Exceedances of the gross alpha, beta gamma, and radium MCLs
- Primary drivers are U-234 & Ra-226
- No exceedances for 10,000 years in grout all and grout & cap alternatives
- No surface water impact predicted



Pu-238			Gross Alpha (15 pCi/L)			Radium (5 pCi/L)			Beta-Gamma (4 mrem/yr)			Peak Time (years)		
ISD Alternative	POA (m)	Nuc	15	15	15	5	5	5	4	4	4	Alpha	Radium	Beta-Gamma
			0-1k	Alpha 0-10k	0-100k	0-1k	0-10k	0-100k	0-1k	0-10k	0-100k	Alpha	Radium	Beta-Gamma
No action	1	Pu-238	0	573	3259	0	190	1054	0	7	39	25260	25060	25150
	100	Pu-238	0	36	363	0	12	118	0	0	4	30860	30650	30750
	Seep	Pu-238	0	1	33	0	0	11	0	0	0			
	UTR Trib	Pu-238	0	0	0	0	0	0	0	0	0	53350	53060	53260
Grout first floor	1	Pu-238	0	78	3579	0	26	1160	0	1	43	32960	32760	32760
	100	Pu-238	0	4	389	0	1	127	0	0	5	38450	38160	38250
	Seep	Pu-238	0	0	34	0	0	11	0	0	0			
	UTR Trib	Pu-238	0	0	0	0	0	0	0	0	0	60660	60360	60550
Grout entire 235-F	1	Pu-238	0	1	3965	0	0	1289	0	0	48	42060	41950	41960
	100	Pu-238	0	0	418	0	0	136	0	0	5	47060	46860	46950
	Seep	Pu-238	0	0	34	0	0	11	0	0	0			
	UTR Trib	Pu-238	0	0	0	0	0	0	0	0	0	68460	68250	68450
Grout entire 235-F with cap	1	Pu-238	0	0	4150	0	0	1354	0	0	50	72260	72160	72260
	100	Pu-238	0	0	415	0	0	135	0	0	5	76960	76750	76950
	Seep	Pu-238	0	0	32	0	0	10	0	0	0			
	UTR Trib	Pu-238	0	0	0	0	0	0	0	0	0	97760	97550	97760

# F&T Modeling - Inventory Removal Requirements

- Concentration/dose at assessment points is linear with inventory
- Mass removal required to meet MCLs can be calculated
- Extensive Pu-238 removal required to meet groundwater MCLs for all time periods

$$d_i^{New} = \left[ \frac{I_i^{New}}{I_i^{Old}} \right] d_i^{Old}$$

ISD Alternative	POA (m)	%Removal Np-237 to reach alpha			%Removal Pu-238 to reach alpha			%Removal Pu-238 to reach radium		
		0-1k	0-10k	0-100k	0-1k	0-10k	0-100k	0-1k	0-10k	0-100k
No action	1	51.3%	97.2%	97.2%	0.0%	97.4%	99.5%	0.0%	97.4%	99.5%
	100	0.0%	86.2%	86.2%	0.0%	58.0%	95.9%	0.0%	57.8%	95.8%
	Seep	0.0%	0.0%	0.0%	0.0%	0.0%	53.9%	0.0%	0.0%	53.1%
	UTR Trib	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Grout first floor	1	0.0%	90.1%	90.1%	0.0%	80.8%	99.6%	0.0%	80.7%	99.6%
	100	0.0%	51.5%	51.5%	0.0%	0.0%	96.1%	0.0%	0.0%	96.1%
	Seep	0.0%	0.0%	0.0%	0.0%	0.0%	55.2%	0.0%	0.0%	54.5%
	UTR Trib	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Grout entire 235-F	1	0.0%	25.6%	63.0%	0.0%	0.0%	99.6%	0.0%	0.0%	99.6%
	100	0.0%	0.0%	0.0%	0.0%	0.0%	96.4%	0.0%	0.0%	96.3%
	Seep	0.0%	0.0%	0.0%	0.0%	0.0%	56.2%	0.0%	0.0%	55.5%
	UTR Trib	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Grout entire 235-F with cap	1	0.0%	0.0%	33.7%	0.0%	0.0%	99.6%	0.0%	0.0%	99.6%
	100	0.0%	0.0%	0.0%	0.0%	0.0%	96.4%	0.0%	0.0%	96.3%
	Seep	0.0%	0.0%	0.0%	0.0%	0.0%	52.9%	0.0%	0.0%	52.2%
	UTR Trib	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

## F&T Modeling - Conclusions

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- Peaks are large but separate from other F Area facilities and each other
- Exceedances occur and extensive holdup removal would be required keep concentration below MCLs
- The use of ISD can delay exceedances past 10,000 years
- Elemental lead and PCBs did not exceed MCLs for the No Action alternative at all POAs for 10,000 years

# Preliminary Human Health Risk Summary

- Indoor Worker receptor scenario
- USEPA Building Preliminary Remediation Goals (BPRG) Calculator
- Estimated concentration in air (pCi/m<sup>3</sup>)
  - Based on 2006 inventory (grams)
  - Convert grams to curies
  - Volume estimate for each portion of facility based on dimensions
- Update for RSER/EE/CA based on revised inventory and current BPRGs

Receptor Scenario	Radionuclide	Entire Building 235-F Risk Estimate	PuFF Cells 1-5 Risk Estimate	ABL Risk Estimate
Default	Pu-238	3E+09	7E+10	2E+08
Indoor	Np-237	1E+04	1E+03	5E+05
Worker	Total Risk =	3E+09	7E+10	2E+08

## Regulatory Path Forward – Deactivation & Decommissioning (D&D) Planning

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- **Regulatory decisions needed that affect remaining deactivation scope**
  - Data needs including radioassays, modeling output (existing data or new?)
  - Acceptable residual radiological holdup (i.e., is further radiological holdup removal required for a protective end state?)
- **Regulatory decisions needed for D&D Planning**
  - POA for exposure to modeled GW concentrations
  - Suite of removal action alternatives for evaluation in RSER/EE/CA
  - Level of detail for removal alternatives, particularly the selected removal alternative
  - Modeling parameter concerns
  - Others identified by the Core Team

## Regulatory Path Forward - RSER/EE/CA

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- **Timing**
  - Proceed with RSER/EE/CA although indeterminate Long Term Safe Storage period may occur before decommissioning is funded?
  - Plan for RSER/EE/CA scoping meeting(s) in FY20 with document submittal in FY21
- **RSER/EE/CA Document**
  - Propose level of detail similar to RSER/EE/CAs for Reactor Buildings and HWCTR
    - *Summary level description of building history, deactivation activities, residual contamination, and removal action alternatives*
    - *Risk Assessment Summary, Fate & Transport Model Summary, and ARARs provided in appendices*
    - *Cost Analysis for each removal action alternative*
    - *Comparison of Removal Action Alternatives (i.e., Effectiveness, Implementability, Cost)*
  - Propose phased approach for implementation of selected alternative
- **Action Memorandum**
  - Documents regulatory agreement on ISD end state for Building 235-F