Plutonium Finishing Plant
Resumption of Work

In June, workers loaded the last of 20 “super sacks” containing previously loaded demolition debris.
Overview

• Event Summary
• Root Cause Evaluation
• External Assessments
• Key Activities
• Resumption of Work Plan
• Enhanced Controls Overview
• Management Assessment
• Enhanced DOE Oversight
Event Summary

• Contamination discovered outside posted radiological boundaries on Dec. 15-19

• 281 workers requested bioassays
  – 270 non detectable (meaning zero dose)
  – 2 doses less than 1 millirem* (notionally less than .02 mrem/year)
  – 8 doses between 1 to 10 millirem* (notionally .02-.2 mrem/year)
  – 1 dose between 10-20 millirem* (notionally .2-.4 mrem/year)

• Dec. 2017 event followed June 2017 contamination spread

• DOE-RL and Regulators issued a stop work

*Doses assigned are the expected dose over 50 years and are below the Hanford administrative dose limit of 500 mrem/year for radiological workers.
Contamination remained in close proximity to the PFP, located in the 200 West Area of the 586-square-mile Hanford Site.
-root Cause Evaluation

- **Root Cause 1:** Over-reliance on selective empirical data gathered during the course of, and following, demolition was used in making decisions on the rate and methods of demolition.

- **Root Cause 2:** Risks and consequences associated with emerging and changing conditions were not adequately reviewed and evaluated.

- **Contributing Cause 1:** Previous success of the application of fixative was assumed to provide equivalent protection to containerized debris or covering the debris with soil.

- **Contributing Cause 2:** Radiological indicators near the PRF demolition site did not indicate the need to expand fixative applications or perform surveys in addition to the established monitoring plan.

- **Extraneous Conditions Adverse to Quality 1:** Prompt notification to management or the DOE-RL Facility Representative did not occur because personnel at the facility did not implement a proper procedure.

- **Extraneous Conditions Adverse to Quality 2:** PFP management did not adequately address all employee concerns and suggestions.
Corrective Action Input

131 Corrective Actions

- **PFP Root Cause Evaluation**
  - 44 corrective actions
  - 37 pre-start actions (33 closed; 4 open)
  - 7 post-start actions (4 closed; 3 open)

- **Plateau Remediation Contract**
  - Radiological Control Improvement Plan
  - 13 corrective actions
  - 10 pre-start actions (10 closed; 0 open)
  - 3 post-start actions (3 closed; 0 open)

- **Department of Energy Office of Enterprise Assessments and Office of Environmental Management Site Observations**
  - 50 corrective actions
  - 35 pre-start actions (33 closed; 2 open)
  - 15 post-start actions (13 closed; 2 open)

- **Jacobs Radiological Control Independent Assessment**
  - 19 corrective actions
  - 12 pre-start actions (12 closed; 0 open)
  - 7 post-start actions (3 closed; 4 open)

- **DOE Expert Panel Input**
  - Worker Involvement

- 88 of 94 Total Pre-Start Actions Completed
Other Key Activities

• Revised Air Dispersion/Ground Deposition Models
  – Pacific Northwest National Laboratory
  – Lawrence Livermore National Laboratory

• Performed Option Engineering Analysis
  – Incorporated input from workers and DOE Expert Panel*

• Developed Enhanced Controls
  – Includes assumptions from air dispersion model

• Developed Resumption of Work Plan

• Planned Management Assessment

*DOE Expert Panel included observers from regulatory agencies, the Hanford Atomic Metal Trades Council and the Building Trades.
PFP Demolition Resumption

The dates are anticipated targets and are subject to change based on issues that may arise or incorporation of lessons learned.

Updated June 29, 2018

*Lower-Risk Activity

Independent Management Review of Readiness for Work

**Higher-Risk Activity

Work Break and Review to Apply Lessons Learned to Next Phase

234-5Z: Main Processing Facility
PRF: Plutonium Reclamation Facility
RBA: Radiological Buffer Area
HCA: High Contamination Area
ARA: Airborne Radioactivity Area

DOE Actions
CHPRC Actions

*Completed

- DOE Expert Panel Input
- Article 32 Response
- DOE HQ/Hill Briefings
- DOE Concurrence
- Stabilization Activities
- Stabilization Complete
- Mgmt Review
- 234-5Z Debris Disposition
- Lessons Learned
- 234-5Z and Vault Demolition
- Install Air Movers For 234-5Z A&C Line Demolition
- Lessons Learned
- Mgmt Review
- Article 32 Response
- DOE Concurrence
- 234-5Z A&C Lines and Tunnel Demolition
- Lessons Learned
- PRF Rubble Disposition

Independent Management Review of Readiness for Work
Work Break and Review to Apply Lessons Learned to Next Phase

Sampling and Cover Cap
Strategy to Resume PFP Demolition
Lower- and Higher-Risk Approaches

Risk based on material-at-risk (MAR) and surface contamination configuration

<table>
<thead>
<tr>
<th>Containerized Waste</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Super Sacks</td>
<td>60%</td>
<td>1835g</td>
</tr>
<tr>
<td>Other</td>
<td>30%</td>
<td>912g</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>90%</strong></td>
<td><strong>2747g</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Lower-Risk Demolition</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A: 234-5Z Debris</td>
<td>&lt;1%</td>
<td>5g</td>
</tr>
<tr>
<td>B: 234-5Z and Vault</td>
<td>&lt;1%</td>
<td>5g</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>10%</strong></td>
<td><strong>312g</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Higher-Risk Demolition</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C: 234-5Z A/C Lines and Tunnel</td>
<td>2%</td>
<td>64g</td>
</tr>
<tr>
<td>D: PRF Rubble Pile</td>
<td>8%</td>
<td>238g</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>10%</strong></td>
<td><strong>312g</strong></td>
</tr>
</tbody>
</table>

**Remaining MAR**
3059g

234-5Z=Main PFP Processing Facility
PRF=Plutonium Reclamation Facility
Summary of Selected Options

A: Disposition Debris from Main Processing Facility (234-5Z):
Use enhanced controls identified from the Root Cause Evaluation and Jacobs’ radiological control assessment to disposition debris created during pre-December 2017 demolition of lower-risk areas of Main Processing Facility (234-5Z)

B: Demolish Main Processing Facility (234-5Z) (Except Processing Lines) and Vault: Implement current zone-by-zone demolition strategy with additional controls developed from the pre-start corrective actions and Jacobs’ radiological control assessment

C: Demolish Processing Lines (A&C) in Main Processing Facility (234-5Z) and Tunnel: Implement current zone-by-zone demolition strategy (supported with a structural engineering analysis) with additional controls, including ventilation on A&C processing lines and tunnel corridor, to enhance particulate control during demolition

D: Disposition Rubble Pile from Plutonium Reclamation Facility (PRF): Add water to the contamination-free soil that currently covers the PRF rubble pile, saturating the soil and preventing contamination migration; heavy equipment will remove the wet soil and rubble and place it in a container for shipment to the Environmental Restoration Disposal Facility
### Enhanced Controls for Lower- and Higher-Risk Scope

<table>
<thead>
<tr>
<th>Control Set</th>
<th>Pre-December 18</th>
<th>Enhanced Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Boundaries</strong></td>
<td>Established from predicted airborne radioactivity and surface deposition models to encompass levels requiring posting and control</td>
<td>Significantly enlarged to ensure no contamination, even below posting limits, is found outside of boundaries</td>
</tr>
</tbody>
</table>
| **Survey Plan** | 45 cookie sheets surveyed once per working day  
Worker-performed personal surveys  
No access restriction for wind events | 77 cookie sheets; surveys twice per working day and during demolition activities  
Automated personal contamination monitors  
Access restricted until post-wind event surveys are complete |
| **Monitoring** | 14 continuous air monitors  
22 air samplers; 3-day air sample turnaround time | 14 continuous air monitors  
35 air samplers (three elevated at 20 ft); 1-day air sample turnaround time  
Evaluating additional air samplers at radiological boundaries |
| **Demolition Sequence** | Parallel building demolitions | Sequential demolition from lower- to higher-risk  
Opportunity for worker involvement and incorporation of lessons learned between tasks |
| **Fixatives** | 3 main fixatives  
• 50% Polymeric Barrier System (PBS)  
• Soil-Sement®  
• Envirotac II® (“Rhino Snot”) | Fixatives used per manufacturers’ specifications with technical evaluations to support; incorporated into work planning documents |
| **Waste Packaging** | Large piles accumulated during demolition  
Environmental Restoration Disposal Facility (ERDF) dozer operator using respiratory protection | Minimize pile accumulation; ensure fixative application  
Wider use of respiratory protection at ERDF, based on waste profile; multiple air samples and surveys taken near waste and downwind |
| **Worker Engagement** | Inconsistent face-to-face communication and worker involvement | Pauses incorporated into demolition sequence for worker involvement and review of lessons learned  
Employee involvement in Root Cause Evaluation, corrective action development, and option evaluation team for demolition resumption  
Weekly employee roundtables scheduled with project management |
| **Work Package** | Large work package with tasks | Smaller work packages with limited tasks  
Rigorous documented change management process (protects control set)  
Independent Hazard Review Board |
| **Oversight** | Hazard Review Board | Hazard Review Board, Senior Supervisory Watch and senior project mentors  
Roles, responsibilities, and participation criteria defined |
## Monitoring and Response

<table>
<thead>
<tr>
<th>Number/Location&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Continuous Air Monitors</th>
<th>Cookie Sheets</th>
<th>Fixed Air Samplers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-Demolition</strong></td>
<td></td>
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<tr>
<td>14 total</td>
<td>Existing 14 CAMs</td>
<td>77 total</td>
<td>35 total</td>
</tr>
<tr>
<td>4 inner CAMs (closer to demolition)</td>
<td>Up to two additional CAMs deployed near work area of job site</td>
<td>47 inside HCA and CA</td>
<td>15 inside HCA and CA</td>
</tr>
<tr>
<td>(24 DAC-hr)</td>
<td>(80 DAC-hr)</td>
<td>18 inside RBA</td>
<td>8 inside RBA</td>
</tr>
<tr>
<td>10 outer CAMs (farther from demolition)</td>
<td>Additional deployed down wind from job site, based on wind direction</td>
<td>12 outside work control zone</td>
<td>3 inside work control zone</td>
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<td></td>
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<td></td>
<td>9 outside work control zone</td>
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<tr>
<td><strong>During Demolition</strong></td>
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<td>12 outside work control zone</td>
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<td>15 inside HCA and CA</td>
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<td></td>
<td></td>
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</tbody>
</table>

### Monitoring Frequency

<table>
<thead>
<tr>
<th></th>
<th>Continuous Air Monitors</th>
<th>Cookie Sheets</th>
<th>Fixed Air Samplers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-Demolition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual once per shift</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Filter paper changed daily or for cause (rate of rise noted)</td>
<td>Continually observed by RCTs</td>
<td>Surveyed twice per day</td>
<td>Near real-time surveys of cookie sheets down wind of demolition and within the demolition HCA, boundary of the HCA and CA</td>
</tr>
<tr>
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<tr>
<td><strong>During Demolition</strong></td>
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### Turnaround Time

<table>
<thead>
<tr>
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<th>Continuous Air Monitors</th>
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<tbody>
<tr>
<td><strong>Non-Demolition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter papers take 24 hr to analyze&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Results every 15 minutes; can differentiate between alpha and background</td>
<td>Results real time</td>
<td>Filter papers take 24 hr to analyze&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td><strong>During Demolition</strong></td>
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</table>

### Action Level

<table>
<thead>
<tr>
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<th>Continuous Air Monitors</th>
<th>Cookie Sheets</th>
<th>Fixed Air Samplers</th>
</tr>
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<tbody>
<tr>
<td><strong>Non-Demolition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upon alarm</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>50% of the chronic alarm set point</td>
<td>&gt;1,600 dpm/100 cm² inside HCA and CA</td>
<td>&gt;1,600 dpm/100 cm² inside HCA and CA</td>
<td>20,000 dpm</td>
</tr>
<tr>
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<tr>
<td><strong>During Demolition</strong></td>
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</table>

### Response

<table>
<thead>
<tr>
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<th>Continuous Air Monitors</th>
<th>Cookie Sheets</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-Demolition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exit area/notify management</td>
<td></td>
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<td></td>
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<tr>
<td><strong>During Demolition</strong></td>
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</tbody>
</table>

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a. Numbers and location may change based on further analysis.
b. Filter paper on CAMs and air samplers at ARA boundaries and downwind are counted every 24 hours, which is required for filter paper analysis for additional CAMs and air samplers as needed due to equipment and employee resources.

ARA = airborne radioactivity area
CA = contamination area
CAM = continuous air monitor
RCT = radiological control technician
## Conduct Of Operations

### Change Management Process

- PFP Manager/Deputy Project Manager oversight

  Recommended changes evaluated against based assumptions and documents developed during planning phase

  Changes may include:
  - Hazard Review Board
  - Corrective Action Review Board
  - RadCon Change Management Program
  - Executive Safety Review Board

  Changes made to the work instructions (statement of scope through restoration/end state) must follow the change process outlined in PRC-PRO-WKM-12115, *Work Management*

### Hazard Review Board (HRB)

- Comprised of a senior manager chairperson and subject matter experts independent of PFP

  Evaluates work documents for hazard controls

  Ensures the work team understands the scope of the work and controls

  All changes, modifications, and revisions to the HRB-approved work packages must be approved by the HRB or HRB chairperson

### Senior Supervisory Watch (SSW)

- Interoffice memorandum CHPRC-1801076, *Updated Plutonium Finishing Plant Senior Supervisory Watch*, provides a clear set of expectations for SSW oversight, feedback to the project, and documentation

  SSW pool:
  - 26 senior managers and subject matter experts
  - 17 of the 26 are outside of PFP

  SSW activities may include:
  - Movement and disposition of waste containers
  - Debris/rubble size reduction and load out
  - Demolition
  - Work conducted outside regular working hours.

  Assigned SSWs and the project manager will sign an expectation of understanding on SSW duties

  PFP-specific SSW checklist facilitates consistency and documentation of SSW observations for review and submission to the Management Observation Process
Employee Engagement

• Held 54 briefings with approximately 1,800 workers since January 2018
• Weekly roundtable discussions held with PFP employees and project leadership
  – Questions and concerns tracked to resolution; responses provided to employees
• Intranet site available for project briefings, recent communications and recently asked questions/answers
• Worked with Mission Support Alliance to improve employee communications related to bioassay and dose consequences
• Incorporated Building Trades’ input to enhanced Environmental Restoration Disposal Facility controls
• Hanford Atomic Metal Trades Council will be involved with Management Review
  – Memorandum of Agreement for an independent review with Stoneturn
• Routine monthly, weekly and daily meetings
Incorporation of Enhanced Controls into Work Planning

- **New Independent Chair**
  - **External HRB Chair**
- **HRB**
- **Walk Down**
- **Management Review**
- **Execution**
- **Post-Job Review**
- **Lessons Learned**
- **Future Work Packages**

**Enhanced Change Management Process**

- **Worker Engagement**
  - **Worker Engagement**
  - **Worker Engagement**
  - **Worker Engagement**
- **Enhanced Monitoring**
- **Expanded Boundaries**
- **Fixative Application**
- **Debris Pile Management**

- **Oversight**
  - **Worker Involvement**
  - **Enhanced Controls**

- **26 Assigned to SSW at PFP; 17 are External to PFP**

**Worker Engagement**

- Help identify and mitigate hazards
- Provide worker perspective for work planning
- Perform walk downs to verify scope and hazards

- Workers relied upon by HRB to validate work package adequacy

- Workers ensure work package can be completed as written

- Workers actively participate in the review

- Workers rely upon by HRB to validate work package adequacy

**Provide feedback for future work package development**

- **HRB=Hazard Review Board**
- **SSW=Senior Supervisory Watch**

**CH2M HILL Plateau Remediation Company**
Resumption of Work Plan

Required Contributing Factors for Successful Implementation

Management Overview/Incorporation of Lessons Learned

Development of Enhanced Control Sets

- Enhanced Controls Identified
- Control Sets Bounded
- Control Sets Delivered
- Control Sets Followed

Options Evaluation

- Options Identified
- Preferred Option Selected
- New Hazards Identified

Resumption of Work Plan

- Demo Sequencing
- ESH&Q Radiological Air Modeling, Survey and Monitoring, Industrial Hazard Controls

Detailed Work Order

- Sequence Steps
- Control and Radiological Boundaries
- ALARA Management Worksheets
- Hazard Review Boards
- Wind Response
- Survey Plans
- Monitoring Plan
- Fixative system
- Waste Acceptance Criteria (WAC)

Execution

- Work Control Document
- Radiological Work Permits
- Pre-Jobs
- Hold Points
- Step-by-Step Fixative Application
- Assigned Senior Supervisory Watch
- ERDF WAC
- Emergency Response Procedure

Conduct of Operations

- Engineering Analysis Structural and Mechanical
- Conduct of Operations
Management Review Process
Prior to Receiving DOE Authorization for Resumption

• Independent review of readiness to resume demolition
• Nominally five team members with expertise in conduct of operations, radiological control
• One week of documentation review
• One week of field work, including mock-up demonstration and emergency drill
• Any deficiencies will be categorized as pre-start or post-start
• DOE on-site team
# Enhanced Department of Energy Oversight

## Enhanced Oversight

<table>
<thead>
<tr>
<th>Staffing</th>
<th>Pre–December 18</th>
<th>Enhanced Oversight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 assigned Facility Representatives (FR)</td>
<td>2 assigned FRs + 1 FR in training</td>
</tr>
<tr>
<td></td>
<td>1 RadCon SME</td>
<td>2 RadCon SME’s</td>
</tr>
<tr>
<td></td>
<td>DOE Office of Environmental Management (EM HQ) and Office of Enterprise Assessment (EA) supplemental oversight of contractor and DOE oversight personnel</td>
<td></td>
</tr>
<tr>
<td>Notifications</td>
<td>High-level notification criteria (ORPS)</td>
<td>Detailed/low-level notification criteria (supplemental PFP notifications)</td>
</tr>
<tr>
<td>Controls</td>
<td>Air dispersion model assumptions not protected</td>
<td>Oversight personnel trained to treat air dispersion model assumptions analogous to Technical Safety Requirement-level controls in the authorization basis</td>
</tr>
<tr>
<td>Status Reports</td>
<td>Periodic general reports to DOE senior management</td>
<td>Weekly detailed reports on PFP to DOE senior management</td>
</tr>
<tr>
<td>Readiness Verification</td>
<td>Oversight of contractor’s Operational Readiness Review provided in 2016 prior to demolition</td>
<td>Team of seven personnel including EM HQ and external consultants providing independent verification of the effective implementation all pre-start corrective actions</td>
</tr>
<tr>
<td>Oversight Process Verification</td>
<td>Periodic self-assessments of federal oversight processes and training</td>
<td>EA conducted an assessment of RL oversight processes and training in June 2018. No findings and several good practices identified.</td>
</tr>
</tbody>
</table>