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)

- **Integrated Safety Management System Assessment**
  - 5 corrective actions
    - 0 pre-start actions
    - 5 post-start actions (1 closed; 4 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)

- **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)

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

Lower- and Higher-Risk Approaches

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

**Containerized Waste**

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentage</th>
<th>Weight</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>
</tr>
</tbody>
</table>

**Lower-Risk Demolition**

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentage</th>
<th>Weight</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>

**Higher-Risk Demolition**

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentage</th>
<th>Weight</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>
<tr>
<td><strong>Survey Plan</strong></td>
<td>45 cookie sheets surveyed once per working day Worker-performed personal surveys No access restriction for wind events</td>
<td>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</td>
</tr>
<tr>
<td><strong>Monitoring</strong></td>
<td>14 continuous air monitors 22 air samplers; 3-day air sample turnaround time</td>
<td>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</td>
</tr>
<tr>
<td><strong>Demolition Sequence</strong></td>
<td>Parallel building demolitions</td>
<td>Sequential demolition from lower- to higher-risk Opportunity for worker involvement and incorporation of lessons learned between tasks</td>
</tr>
<tr>
<td><strong>Fixatives</strong></td>
<td>3 main fixatives • 50% Polymeric Barrier System (PBS) • Soil-Sement® • Envirotac II® (“Rhino Snot”)</td>
<td>Fixatives used per manufacturers’ specifications with technical evaluations to support; incorporated into work planning documents</td>
</tr>
<tr>
<td><strong>Waste Packaging</strong></td>
<td>Large piles accumulated during demolition Environmental Restoration Disposal Facility (ERDF) dozer operator using respiratory protection</td>
<td>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</td>
</tr>
<tr>
<td><strong>Worker Engagement</strong></td>
<td>Inconsistent face-to-face communication and worker involvement</td>
<td>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</td>
</tr>
<tr>
<td><strong>Work Package</strong></td>
<td>Large work package with tasks</td>
<td>Smaller work packages with limited tasks Rigorous documented change management process (protects control set) Independent Hazard Review Board</td>
</tr>
<tr>
<td><strong>Oversight</strong></td>
<td>Hazard Review Board</td>
<td>Hazard Review Board, Senior Supervisory Watch and senior project mentors Roles, responsibilities, and participation criteria defined</td>
</tr>
<tr>
<td>Number/Location</td>
<td>Continuous Air Monitors</td>
<td>Non-Demolition</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Non-Demolition</strong></td>
<td>• 14 total</td>
<td>• Existing 14 CAMs</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td>• 4 inner CAMs (closer to demolition)</td>
<td>• 47 inside HCA and CA</td>
</tr>
<tr>
<td></td>
<td>• (24 DAC-hr)</td>
<td>• 12 outside work control zone</td>
</tr>
<tr>
<td></td>
<td>• 10 outer CAMs (farther from demolition)</td>
<td>• Existing 14 CAMs</td>
</tr>
<tr>
<td></td>
<td>(8 DAC-hr)</td>
<td>• Up to two additional CAMs deployed near work downwind of job site (80 DAC-hr)</td>
</tr>
<tr>
<td><strong>Monitoring Frequency</strong></td>
<td>• Visual once per shift</td>
<td>• Continually observed by RCTs</td>
</tr>
<tr>
<td><strong>Turnaround Time</strong></td>
<td>• Filter papers take 24 hr to analyze b</td>
<td>• Results every 15 minutes; can differentiate between alpha and background</td>
</tr>
<tr>
<td><strong>Action Level</strong></td>
<td>• Upon alarm</td>
<td>• &gt;1,600 dpm/100 cm² inside HCA and CA</td>
</tr>
<tr>
<td><strong>Response</strong></td>
<td>• Exit area/notify management</td>
<td>• Notify FWS</td>
</tr>
<tr>
<td></td>
<td>• Stop demolition</td>
<td>• Evaluate need for additional water/fixative</td>
</tr>
</tbody>
</table>

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- **ARA** = airborne radioactivity area
- **CA** = contamination area
- **CAM** = continuous air monitor
- **RCT** = radiological control technician

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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.
### Conduct Of Operations

<table>
<thead>
<tr>
<th>Change Management Process</th>
<th>Hazard Review Board (HRB)</th>
<th>Senior Supervisory Watch (SSW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFP Manager/Deputy Project Manager oversight</td>
<td>Comprised of a senior manager chairperson and subject matter experts independent of PFP</td>
<td>Interoffice memorandum CHPRC-1801076, <em>Updated Plutonium Finishing Plant Senior Supervisory Watch</em>, provides a clear set of expectations for SSW oversight, feedback to the project, and documentation</td>
</tr>
<tr>
<td>Recommended changes evaluated against based assumptions and documents developed during planning phase</td>
<td>Evaluates work documents for hazard controls</td>
<td>SSW pool:</td>
</tr>
<tr>
<td>Changes may include:</td>
<td>Ensures the work team understands the scope of the work and controls</td>
<td>• 26 senior managers and subject matter experts</td>
</tr>
<tr>
<td>• Hazard Review Board</td>
<td></td>
<td>• 17 of the 26 are outside of PFP</td>
</tr>
<tr>
<td>• Corrective Action Review Board</td>
<td></td>
<td>SSW activities may include:</td>
</tr>
<tr>
<td>• RadCon Change Management Program</td>
<td></td>
<td>• Movement and disposition of waste containers</td>
</tr>
<tr>
<td>• Executive Safety Review Board</td>
<td></td>
<td>• Debris/rubble size reduction and load out</td>
</tr>
<tr>
<td>Changes made to the work instructions (statement of scope through restoration/end state)</td>
<td>All changes, modifications, and revisions to the HRB-approved work packages must be approved by the HRB or HRB chairperson</td>
<td>• Demolition</td>
</tr>
<tr>
<td>(statement of scope through restoration/end state) must follow the change process outlined in PRC-PRO-WKM-12115, <em>Work Management</em></td>
<td></td>
<td>• Work conducted outside regular working hours.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Assigned SSWs and the project manager will sign an expectation of understanding on SSW duties</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PFP-specific SSW checklist facilitates consistency and documentation of SSW observations for review and submission to the Management Observation Process</td>
</tr>
</tbody>
</table>
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

PFP radiological control supervisor holds a discussion with his team about emergency response activities
Incorporation of Enhanced Controls into Work Planning

**New Independent Chair**
- External HRB Chair

**Work Package Development**
- HRB
- Walk Down
- Management Review
- Execution
- Post-Job Review
- Lessons Learned
- Future Work Packages

**Enhanced Change Management Process**
- **Worker Engagement**
  - Help identify and mitigate hazards
  - Provide worker perspective for work planning
  - Perform walk downs to verify scope and hazards
- **Worker Engagement**
  - Workers relied upon by HRB to validate work package adequacy
- **Worker Engagement**
  - Workers ensure work package can be completed as written
- **Worker Engagement**
  - Workers actively participate in the review

**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
- Workers actively participate in the review

Provide feedback for future work package development

- HRB=Hazard Review Board
- SSW=Senior Supervisory Watch
Resumption of Work Plan

Required Contributing Factors for Successful Implementation

- Enhanced Controls Identified
- 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)
- Control Sets Followed
  - Work Control Document
  - Radiological Work Permits
  - Pre-Jobs
  - Hold Points
  - Step-by-Step Fixative Application
  - Assigned Senior Supervisory Watch
  - ERDF WAC
  - Emergency Response Procedure
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

<table>
<thead>
<tr>
<th></th>
<th>Pre–December 18</th>
<th>Enhanced Oversight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Staffing</strong></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></td>
<td>DOE Office of Environmental Management (EM HQ) and Office of Enterprise Assessment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(EA) supplemental oversight of contractor and DOE oversight personnel</td>
</tr>
<tr>
<td><strong>Notifications</strong></td>
<td>High-level notification criteria (ORPS)</td>
<td>Detailed/low-level notification criteria (supplemental PFP notifications)</td>
</tr>
<tr>
<td><strong>Controls</strong></td>
<td>Air dispersion model assumptions not protected</td>
<td>Oversight personnel trained to treat air dispersion model assumptions analogous to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical Safety Requirement-level controls in the authorization basis</td>
</tr>
<tr>
<td><strong>Status Reports</strong></td>
<td>Periodic general reports to DOE senior management</td>
<td>Weekly detailed reports on PFP to DOE senior management</td>
</tr>
<tr>
<td><strong>Readiness Verification</strong></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><strong>Oversight Process Verification</strong></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>