Hanford Site
Waste Management Area C
Performance Assessment
Current Status

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Wednesday, January 7, 2015
Presentation Outline

- Background and Status: Waste Management Area C (WMA C) Performance Assessment

- Selected Topics
  - Tank and grout degradation modeling approach
  - Evaluating effects of vadose zone heterogeneities on model results
Hanford Site Tank Farms

Waste Management
Area C

Single-Shell Tanks
Double-Shell Tanks
Waste Management Area C Operational History

- Constructed in 1943–1944
- Operated from 1946 through mid-1980s storing and transferring waste
- Due to long operational history, WMA C received waste generated by essentially all of the Hanford Site major chemical processing operations
Waste Management Area C Operational Period Releases

Summary of Past Releases

- C-101 → 37,000 Gal
- C-104 → 28,000 Gal
- C-105 → 2,000 Gal
- C-108 → 18,000 Gal
- C-110 → 2,000 Gal
- C-112 → 7,000 Gal
- UPR-81 → 36,000 Gal
- UPR-82 → 2,600 Gal
- UPR-86 → 17,000 Gal

Total Releases → 149,600 Gal

RPP-ENV-33418, 2014, Hanford C-Farm Leak Assessments Report, Rev. 3.
(RPP = River Protection Project)
Waste Management Area C Retrieval Status

Ten SSTs
- Retrieval complete
- Inventory based on sampled residuals and final residual volumes
- Seven tanks with release rate studies

Three SSTs
- Retrieval complete and sampling underway
- Inventory estimated from chemical process knowledge and final residual volumes

Three SSTs
- Retrieval ongoing
- Inventory estimated from chemical process knowledge and estimated volume at closure

1 Pacific Northwest National Laboratory has completed release rate studies on tank residuals for Tanks C-103, C-106, C-108, C-109, C-202, C-203, and C-204, and is starting on C-104
Residual Inventories of Key COPCs at Closures

<table>
<thead>
<tr>
<th></th>
<th>Technetium-99 (Ci)</th>
<th>Total Uranium (kg)</th>
<th>Chromium (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrieved SSTs</td>
<td>7.81E-01</td>
<td>4.92E+03</td>
<td>7.26E+01</td>
</tr>
<tr>
<td>SSTs Undergoing Retrieval(^1)</td>
<td>1.00E+00</td>
<td>1.07E+03</td>
<td>2.62E+01</td>
</tr>
<tr>
<td>Ancillary Equipment</td>
<td>5.45E-02</td>
<td>1.08E+03</td>
<td>2.94E+01</td>
</tr>
<tr>
<td>Pipelines</td>
<td>4.61E-02</td>
<td>9.12E+02</td>
<td>2.49E+01</td>
</tr>
<tr>
<td>Total</td>
<td>1.88E+00</td>
<td>7.98E+03</td>
<td>1.53E+02</td>
</tr>
</tbody>
</table>

\(^1\) Inventory estimated using regulatory goal for retrieval of approximately 2,700 gals.


COPC = chemical of potential concern.
Hanford (Hf1) gravels

Hanford (Hf3) unsaturated gravels

Hanford (Hf3) saturated gravels

Backfill

Hanford (Hf2) sands

Complimentary use of Process-Level and System-Level Models

- Rigorous Representation of Physics and Chemistry
- Uncertainties in Events, Processes, and Parameters
- Process Modeling (STOMP)
- System Modeling (GoldSim)
- Deterministic Modeling with Sensitivity Analysis
- Improved Understanding of Role of Uncertainties & Implications on System Performance
- Probabilistic Modeling with Uncertainty Analysis
Performance Assessment Approach with Numerical Model

- **Denominator Case (Established in Scoping)**
  - Current estimates of tank residuals
  - Diffusion-controlled release for grouted tanks and equipment
  - Advection-controlled release for pipelines

- **Sensitivity Cases**
  - Selected tank degradation cases (diffusion-controlled to advection-controlled releases at selected tank degradation times after closure)
  - Selected recharge sensitivity cases
  - Selected upper bound residual inventories
  - Alternative hydrogeologic conceptual model sensitivity cases
    - Hydrogeologic conceptual model from Nez Perce Tribe
    - Highly heterogeneous representation
Denominator Case Model Based on STOMP

Interpolation of Alternative Geologic Model I onto Finite Difference Grid used in STOMP

Grid discretization in x and y directions ranges from 3 m in the vicinity of WMA C to 20 m at the boundaries. Grid discretization in z direction ranges between 1 m to 1.25 m in the vadose zone.
Hydraulic Properties of Waste Management Area C Model

Note: 100 mm/yr = 3.2E-07 cm/s
3.5 mm/yr = 1.1E-08 cm/s
0.5 mm/yr = 1.6E-09 cm/s
### Denominator Case Recharge Rates

<table>
<thead>
<tr>
<th>Surface Soil Type</th>
<th>Historic Simulation (pre-2020) (initial hydraulic conditions)</th>
<th>Predictive Simulation (post-2020) (calculation of peak groundwater concentration)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hanford sand, disturbed</td>
<td>3.5</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Denominator Case Recharge Rates (cont.)

Alternative Recharge Scenario

Recharge (mm/yr)

Calendar Year

Phase

Pre-Hanford  Operational  Institutional Control  Barrier Design Life  Post-Barrier Design Life
Recharge Rates Outside of Waste Management Area C (Operational Period)
Waste Management Area C Model Domain and Points of Calculation in Groundwater
Unconfined Aquifer Properties

Hydraulic conductivity – 3,000 m/day
Basic Modeling Approach

- Flow field (and select transport analysis) calculated with STOMP
  - Initial period (tanks intact)
  - Late period (tanks degraded)
- Flow field abstracted into GoldSim system model
- System model used for:
  - Release from residuals
  - Contaminant transport
  - Exposure-related calculations
System Modeling Implementation Status

- Flow abstracted and evaluated in GoldSim-based system model
  - For intact and fully degraded tank cases
- Working system-level models for all sources
  - Twelve 100-series tanks
  - Four 200-series tanks
  - CR-vault
  - C-301 catch tank
  - Pipelines
System Modeling Implementation Status (cont.)

- Waste release models implemented in system-level models
  - Diffusion-controlled release
  - Advection-controlled release
  - Release models from Pacific Northwest National Laboratory waste release experiments (technetium-99, chromium, and uranium)

- Exposure scenarios
  - All pathways
  - Air pathway/radon transport
  - Groundwater protection
  - Inadvertent intruder (acute and chronic exposure)
Anticipated Performance Assessment Schedule

- Complete and submit Performance Assessment, Rev. 0 documentation for tank residual impacts – October 2015
  - DOE O 435.1 performance assessment for radiological impacts
  - RCRA closure analysis for hazardous chemicals impacts