Niagara Falls Storage Site
Safety Measures During Remediation

On-Site Worker Protection
- Fully enclosed Retrieval Facility
- Remote excavation and handling of residues
- Safety, security and emergency response training

Community and Environmental Protection
- Regular environmental surveillance continues
- Radon Control System
- Monitoring during remediation

Transportation and Disposal Safety
- Secure transport
- Waste will be in sealed, stabilized and radiologically scanned containers to ensure safe rail transport
- Disposal at authorized off-site facility
Niagara Falls Storage Site—Feasibility Study for the Interim Waste Containment Structure Operable Unit

ALTERNATIVE 2 ENHANCED CAP

Enhanced Cap Detail

- **Subsurface soil, topsoil, and grass (24 in.).** Reduces potential for erosion.
- **Rock rip-rap bioinvasion layer (18 in.).** Protects against erosion, root penetration, and damage caused by burrowing animals.
- **Sand drainage layer (6 in.).** Diverts water to resist water infiltration.
- **Geomembrane (0.06 in.).** Engineered liner to resist water infiltration.
- **Existing compacted clay cap (36 in.).** Resists water infiltration and prevents radon emissions and gamma radiation.
- **Rock rip-rap bioinvasion layer, average rock diameter 8 in.**
- **Subsurface soil, topsoil, and grass (24 in.).**

Approximate line of cross section

- **R-10 residues**
- **Line of cross section**
- **Subunit C**
- **Subunit B**
- **Subunit A**
- **Building 411 walls and floor**
- **Brown clay**
- **Gray clay**
- **Central Drainage Ditch**
- **New gabion rock wall (retaining wall) for slope stability enhancement and armoring**
- **New rock rip-rap armoring for erosion protection**

**Vegetated diversion channels and rock-lined waterways added to surface to provide erosion protection**

**Vegetated slopes made more level to increase stability**

**Approximate height of IWCS: 36 ft. from ground surface**

**Maximum probable flood level**

**100-year flood level**

**Building 411 walls and floor**

**Building 411**

**Central Drainage Ditch**

**Approximate line of cross section**

**Vertical exaggeration 2.5:1**
### Niagara Falls Storage Site—Feasibility Study for the Interim Waste Containment Structure Operable Unit

#### RETRIEVAL OF K-65, L-30, L-50, AND F-32 RESIDUES

**CONCEPTUAL MODEL FOR EXCAVATION AND PROCESSING OF SUBUNIT A (REMEDIAL ALTERNATIVES 3A, 3B, AND 4)**

<table>
<thead>
<tr>
<th>GENERAL SITE LAYOUT</th>
<th>GENERAL PROCESS STEPS</th>
<th>PROCESS SUB-STEPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrieval Facility containment building with active excavation.</td>
<td><strong>1. RETRIEVAL</strong></td>
<td>1A Construct facilities and support areas.</td>
</tr>
<tr>
<td>Remote-operated excavator.</td>
<td><strong>2. WASTE HANDLING</strong></td>
<td>1B Remove IWCS to top of Buildings 411, 413, and 414 walls. This leaves material in place above residues as a radiation shield.</td>
</tr>
<tr>
<td></td>
<td><strong>3. WASTE STABILIZATION</strong></td>
<td>1C Scrape back and expose residues in a small area. Use Radon Control System collection hood for supplemental collection of Process Area contaminated air.</td>
</tr>
<tr>
<td></td>
<td><strong>4. TRANSPORTATION AND DISPOSAL</strong></td>
<td>1D Use remote equipment to remove K-65 residues.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1E Deliver residues to Waste Handling Facility in loading cart.</td>
</tr>
</tbody>
</table>

**Note:** All work in Containment Building is done remotely.
Niagara Falls Storage Site—Feasibility Study for the Interim Waste Containment Structure Operable Unit

WASTE HANDLING OF RESIDUES AND ASSOCIATED WASTES RECEIVED FROM THE RETRIEVAL FACILITY

CONCEPTUAL MODEL FOR EXCAVATION AND PROCESSING OF SUBUNIT A (REMEDIAL ALTERNATIVES 3A, 3B, AND 4)

GENERAL SITE LAYOUT

CONTAINMENT SYSTEM (RCS BUILDING)

STABILIZATION FACILITY

WASTE HANDLING FACILITY

RETRIEVAL FACILITY

WASTE CONTAINER STAGING/ TRUCK LOADING AREA

RADON CONTROL SYSTEM

GENERAL PROCESS STEPS

1. RETRIEVAL
2. WASTE HANDLING
3. WASTE STABILIZATION
4. TRANSPORTATION AND DISPOSAL

PROCESS SUB-STEPS

2A Load empty container onto cart dolly.
2B Transport dolly through airlock and into process area.
2C Load waste from Retrieval Facility into cart.
2D Process waste through grinder and screens for size reduction. Oversize waste loaded into disposal containers in Retrieval Facility.
2E Transfer waste to conditioning tank.
2F Mix waste, water, and chemical additive to produce slurry.
2G Transfer slurry to Stabilization Facility.

Note: All work in Waste Handling Facility is done remotely.
Niagara Falls Storage Site—Feasibility Study for the Interim Waste Containment Structure Operable Unit

WASTE STABILIZATION OF K-65 RESIDUES
CONCEPTUAL MODEL FOR EXCAVATION AND PROCESSING OF SUBUNIT A (REMEDIAL ALTERNATIVES 3A, 3B, AND 4)

GENERAL SITE LAYOUT

RADON CONTROL SYSTEM (RCS) BUILDING

CRANE CARRYING IP-2 CONTAINER

IP-2 CONTAINER BEING TRANSPORTED THROUGH AIRLOCK

CRANE CARRYING IP-2 CONTAINER

DRY ADDITIVE SILOS

ADDITIVE CONTROLLING MOTORS ABOVE MIXING ROOM

IP-2 CONTAINER BEING LIDED

GENERAL PROCESS STEPS

1. RETRIEVAL

2. WASTE HANDLING

3. WASTE STABILIZATION

4. TRANSPORTATION AND DISPOSAL

PROCESS SUB-STEPS

3A Stage empty IP-2 containers in building.
3B Transport container through airlock into process area.
3C Load waste slurry into mixer.
3D Mix cement, fly ash, and slurry in set proportions.
3E Put stabilized waste mixture into IP-2 container.
3F Remove free liquid (if present) with absorbent. Install lid.
3G Decontaminate container exterior and survey to ensure it meets all limits (radiological safety, Department of Transportation, and disposal facility).
3H Load container on trailer and transport to container staging area.

Note: all photos are from the Fernald K-65 project
Niagara Falls Storage Site—Feasibility Study for the Interim Waste Containment Structure Operable Unit

RADON CONTROL SYSTEM

CONCEPTUAL MODEL FOR EXCAVATION AND PROCESSING OF SUBUNIT A (REMEDIAL ALTERNATIVES 3A, 3B, AND 4)

- Construct Radon Control System (RCS) prior to exposing residues in excavation.
- Operate RCS continuously throughout residue retrieval, waste handling, and stabilization.
- Maintain negative pressure in facilities to prevent radon release.
- Filter air from Process Areas (unoccupied, higher radioactivity areas in the Retrieval Facility, Waste Handling Facility, Stabilization Facility, and at radon collection hoods) through carbon filters and then high efficiency particulate air (HEPA) filters.
- Filter air from Work Areas (occupied, lower radioactivity or clean control rooms, staging areas, and sealed container processing) through HEPA filters. Less filtering is needed in Work Areas because radon levels are lower by design.

RCS flow and treatment/filtering detail for Process Area air

1. Air from Process Area enters RCS
2. Air passes through coarse filters
3. Condensation liquids held in hold-up tank
4. Air passes through carbon beds to remove radon and other radionuclides
5. Treated air exits carbon beds
6. Treated air passes through HEPA filters for additional radionuclide and particulate removal
7. Fans drive air through system
8. Treated and confirmed clean air exhausted through stack
9. Treated air recycled to Process Areas or exhausted if meets limits

GENERAL SITE LAYOUT

GENERAL PROCESS STEPS

1. RETRIEVAL
2. WASTE HANDLING
3. WASTE STABILIZATION
4. TRANSPORTATION AND DISPOSAL

Process flow diagram for the RCS

- 1,000 CFM* pumps
- 40,000 CFM* pumps
- Stack 82,000 CFM

Return to Process Areas
Niagara Falls Storage Site—Feasibility Study for the Interim Waste Containment Structure Operable Unit

Transportation and Disposal of Stabilized K-65 Residues

Conceptual Model for Excavation and Processing of Subunit A (Remedial Alternatives 3A, 3B, and 4)

<table>
<thead>
<tr>
<th>Type of Waste</th>
<th>Volume Removed (yd³)</th>
<th>Waste and Container Type</th>
<th>Number of Truck Shipments</th>
<th>Truck Shipments Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-65 residues and commingled L-30 and F-32 residues</td>
<td>6,030</td>
<td>Stabilized waste in IP-2 containers</td>
<td>3,800</td>
<td>2 years</td>
</tr>
<tr>
<td>Other Subunit A wastes</td>
<td>22,410</td>
<td>Soil-like waste in supersacks and debris in B-25 boxes</td>
<td>4,000</td>
<td>2 years</td>
</tr>
</tbody>
</table>

Transportation to disposal facility
- Assumed disposal facility for the Proposed Plan is Waste Control Specialists, Andrews, Texas. A different (fully licensed) facility may be selected in the IWCS Remedial Design.
- The actual route will be determined based on public health protection, security, and feasibility.
- Approximate length of route: 1,800 miles.

Disposal at a licensed facility
- Containers will be surveyed and inspected prior to acceptance for disposal.
- Disposal will be in lined, below-ground pits with monitoring.
- This photograph shows disposal of Fernald stabilized K-65 waste in IP-2 containers at Waste Control Specialists, Texas.
Niagara Falls Storage Site—Feasibility Study for the Interim Waste Containment Structure Operable Unit

SITE PREPARATION AND PLANNING FOR REMOVAL ACTIVITIES

CONCEPTUAL MODEL FOR EXCAVATION AND PROCESSING OF SUBUNITS B AND C (REMEDIAL ALTERNATIVES 3A, 3B, AND 4)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Year 7</th>
<th>Year 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Planning</td>
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<tr>
<td>Construction of Infrastructure</td>
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</tr>
<tr>
<td>Subunits B/C Removal to Access Subunit A</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Subunit A Retrieval/Stabilization/Disposal</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Subunit C Excavation/Disposal</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Subunit B Excavation/Disposal</td>
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<td></td>
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<td></td>
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<tr>
<td>Facility Demolition and Decommissioning</td>
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<td></td>
<td></td>
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<tr>
<td>Site Restoration</td>
<td></td>
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</tr>
</tbody>
</table>

Note: these activities will support removal of Subunit A as well as Subunits B and C

- Schedule is based on project funding of $70 million per project year. Reduced funding may extend the schedule.
- Schedule assumes active remediation occurs from March to November each year.

WATER TREATMENT SYSTEM DETAIL

Basin sampled to maintain treatment system and ensure water is below release limits.
ON-SITE WASTE REMOVAL, SEGREGATION, AND PACKAGING

CONCEPTUAL MODEL FOR EXCAVATION AND PROCESSING OF SUBUNITS B AND C (REMEDIAL ALTERNATIVES 3A, 3B, AND 4)

2A. Remove clean soil
- Remove uncontaminated topsoil and uncontaminated portion of clay layer.
- Place clean topsoil and clay in soil stockpile.

2B. Excavate waste material
- Removal by typical construction equipment.
- Conduct continuous monitoring.
- Classify wastes for segregation.

2C. Segregate waste
- Segregated by waste classification.
- Segregation based on on-site analysis and waste profiles.
- Place waste into separate piles for each waste classification (below).
- Reduce size of debris to fit into containers.

11e.(2) waste
- Wastes associated with the uranium ore residues in the IWCS.
- Expected to be the majority of the Subunits B and C waste volume.

R-10 residues
- R-10 uranium ore residues from R-10 pile.
- Expected to be soil-like, similar to other residues.

Low-Level Radioactive Waste (LLRW)
- Other radiologically contaminated wastes not identified as 11e.(2) or R-10 residues.
- May be a small volume.

2D. Load waste into containers
- Load soil-like waste into soft-sided containers (e.g., supersacks).
- Load debris into boxes (typically B-25 boxes). Debris includes building rubble, piping, and other equipment used to handle residues.
- Clearly label containers with waste type (per regulations) to ensure wastes are managed separately.
- Survey and inspect containers after loading to ensure they meet radiological and Department of Transportation limits.

2E. Load waste onto trucks for transport to intermodal facility
- Establish loading area at edge of IWCS.
- Load containers onto a flatbed truck.
- Conduct radiological survey on each container prior to leaving the Niagara Falls Storage Site. Levels must be at or below radiological safety levels and Department of Transportation limits before leaving the site.
- Use new haul roads constructed at IWCS to ensure safety.
- All containers clearly labeled with waste type (per regulations).
### 3A. Local transport to intermodal facility
- Waste containers are transported on flatbed trucks to a local intermodal facility (within 25 miles of IWCS).
- Intermodal is the preferred transport method over truck-only or rail-only based on safety and cost.

### Approximate truck shipments by remedial alternative

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Approximate number of truck shipments</th>
<th>Truck shipment duration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To IWCS for construction</td>
<td>Off-site for disposal</td>
</tr>
<tr>
<td>2. Enhanced Containment of Subunits A, B, and C</td>
<td>7,800 (cap construction)</td>
<td>0</td>
</tr>
<tr>
<td>3A. Removal, Treatment, and Off-Site Disposal of Subunits A with Enhanced Containment of Subunits B and C</td>
<td>10,100 cap and backfill</td>
<td>3,800 (IP-2)</td>
</tr>
<tr>
<td>3B. Removal, Treatment, and Off-Site Disposal of Subunits A and B Enhanced Containment of Subunit C</td>
<td>5,700 cap and backfill</td>
<td>3,800 (IP-2)</td>
</tr>
<tr>
<td>4. Removal, Treatment, and Off-Site Disposal of Subunits A, B, and C</td>
<td>0 (see note)</td>
<td>3,800 (IP-2)</td>
</tr>
</tbody>
</table>

**Note:** Staged clean soil from excavation provides material for site restoration (backfill and grading)