Portsmouth/Paducah Project Office (PPPO)

Midwestern Radioactive Materials Transportation Committee Meeting

Depleted Uranium Hexafluoride Conversion Project Overview
Reinhard Knerr, DUF₆ Federal Project Director

December 14, 2017
Three Gaseous Diffusion Plants (GDP) conducted uranium enrichment activities in Portsmouth, OH, Paducah, Kentucky, and Oak Ridge, Tennessee.

- Sites chosen for uranium enrichment for national security applications in the early 1950’s
- The sites are Cold War facilities that are nearing or at the end of their lifecycle. GDP reservations currently being analyzed for future use scenarios.
- The East Tennessee Technology Park (ETTP) in Oak Ridge D&D is nearly complete
- Portsmouth and Paducah Gaseous Diffusion Plants are undergoing D&D currently

COLD WAR
1952-1989
Nuclear Defense

POST COLD WAR - Commercial Power
1989-2013
Commercial Nuclear Power

POST COLD WAR - Environmental
1989-Current
- Cleanup
- Decontamination & Decommissioning
- Reuse
PPPO Opens

- Portsmouth/Paducah Project Office (PPPO) established in 2002 to focus on Portsmouth and Paducah site cleanup activities

- Current missions:
  - Environmental remediation
  - Decontamination & Decommissioning
  - DUF₆ conversion operations and cylinder yard/cylinder management

- Part of cleanup is the safe conversion and disposition of the Department’s inventory of depleted uranium hexafluoride (DUF₆) stored in ~66,500 steel cylinders

Senator Jim Bunning joined then-PPPO Manager Bill Murphie in PPPO opening ceremony in Lexington.
Paducah – Former Gaseous Diffusion Plant site is located in Western Kentucky (3,556-acre federal facility)
Portsmouth – Former Gaseous Diffusion Plant site is located in South Central Ohio (3,777-acre federal facility)
DUF₆ Conversion Project Mission

• Operate conversion facilities to safely convert DUF₆ into a more stable chemical form (oxide) for beneficial reuse or disposal thus reducing immediate and future risk to workers and surrounding community.
**DUF\textsubscript{6} Inventory**

- DUF\textsubscript{6} results from ~50 years of uranium enrichment at the Department’s Gaseous Diffusion Plants
- DUF\textsubscript{6} placed in cylinders for future DOE use/processing:
  - Further enrichment
  - Conversion to depleted uranium metal
- Cylinders previously stored at ETTP have been shipped to Portsmouth

### Remaining Inventory

<table>
<thead>
<tr>
<th>DOE Facility</th>
<th># DUF\textsubscript{6} Cylinders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paducah Gaseous Diffusion Plant</td>
<td>~43,000</td>
</tr>
<tr>
<td>Portsmouth Gaseous Diffusion Plant</td>
<td>~19,000</td>
</tr>
<tr>
<td>Total Number of Cylinders and Weight</td>
<td><strong>62,000</strong> (~755K MT)</td>
</tr>
</tbody>
</table>
What Is a DUF$_6$ Cylinder?

- Typical size for a cylinder is four feet high (48 inches in diameter, ~12 feet long)
- 10-ton thick-walled cylinder weighs ~4,500 lbs. empty (can hold 20,000 lbs. of DUF$_6$)
- 14-ton thin-walled cylinder weighs 2,600 lbs. empty (can hold 28,000 lbs. of DUF$_6$)
Why Convert?

- DUF$_6$ cylinders routinely stored at GDP sites, but represents a potential hazard to workers and the public through inadvertent release of HF in event of cylinder breach
- DUF$_6$ is converted to uranium oxide (predominately U$_3$O$_8$), loaded into modified cylinders for on-site storage and eventual off-site disposal
- Uranium oxide is insoluble and does not react with either water or air
- Uranium oxide is a stable chemical form optimum for long-term storage and/or disposal
DUF₆ Project Timeline

- **Groundbreaking**
- **2004**: PORTS Complete Construction
- **2008**: PORTS First DUF₆ Flow
- **2010**: Complete PORTS DUF₆ Conversion
- **2011**: PORTS Complete Construction
- **2034**: Pad Ops (~36 yrs) ~43,000 Cylinders Remaining
- **2047**: D&D Following Ops

- **2008**: D&D Following Ops
- **2011**: Complete PAD DUF₆ Conversion
- **2034**: Pad Ops (~36 yrs) ~43,000 Cylinders Remaining
- **2047**: D&D Following Ops

- **2008**: Follow-on Ops?
- **2034**: Follow-on Ops?
- **2047**: Follow-on Ops?

- **2004**: Ports Ops (~24 yrs) ~19,000 Cylinders Remaining
DUF₆ Conversion Products

• Project conversion throughput goal - 31,500 MT DUF₆ per year:
  – 18,000 MT at Paducah
  – 13,500 MT at Portsmouth

• Conversion will generate two co-products:
  – Oxide which will fill approximately 3,000 cylinders per year:
    • 1,100/yr at Portsmouth
    • 1,900/yr at Paducah
  – Aqueous Hydrofluoric Acid which will fill approximately 145 rail tank cars per year (~2.9M gal):
    • ~55 tank cars/yr at Portsmouth (1.1M gal)
    • ~90 tank cars/yr at Paducah (1.8M gal)
Cylinders used to store DUF₆ are modified with a flange on one end for filling with oxide and used as the shipping container. Modified cylinders are inspected and certified as DOT compliant Industrial Packaging shipping containers prior to filling with oxide. Gondola railcars were modified for transportation of uranium oxide cylinders.
Cumulative DUF₆ Converted

DUF₆ Converted/Oxide Cylinders Generated – Total To Date: 59,646 MT DUF₆ /~4,650 Cylinder Oxide
Aqueous Hydrofluoric Acid

• The desired form is a 49% HF/51% H₂O solution. An HF recovery system is employed to collect the HF for recycle into industry.

• Release and recycle of HF has significant benefits:
  – Avoids further processing and significant additional disposal costs of HF neutralization product calcium fluoride (CaF₂)
  – Beneficial Reuse from Resource Recovery
  – Off-sets a portion of operating costs
Through September 2017 – 9,605,000 gallons of HF generated and recycled into commerce
• DOE continues to seek reuse opportunities for the DUF₆ inventory, including processing to retrieve usable fissile uranium

• About 40% of the inventory is suitable for re-enrichment depending on market forces and use of current enrichment technology

• DOE has an agreement with a commercial company for re-enrichment using laser enrichment process should the company elect to proceed with construction of a facility
DUF$_6$ Reuse (cont.)

- DUF$_6$ resulting from re-enrichment would be returned to DOE inventory at Paducah which will extend conversion operations.
- Conversion of DOE DUF$_6$ to oxide is currently restricted to that portion of the inventory that is not suitable for re-enrichment.
- Converting the not suitable portion will take around 10 years at Portsmouth and 44 years at Paducah rather than 17 years and 27 years for the full Portsmouth and Paducah inventories.
Completion of the NEPA process is required prior to initiating transportation and disposal of converted oxide

**Phase 1:** Programmatic Environmental Impact Statement assessed the potential impacts of alternative strategies for managing the DUF₆ – *completed 1999*

**Phase 2:** Site-specific Final Environmental Impact Statements (FEIS) addressed potential environmental impacts from: 1) construction, operation, maintenance, and D&D of the conversion facilities; 2) transportation of conversion products to disposal facilities; and, 3) transportation, sale, use, or disposal of the HF – *completed 2004*

**Phase 3:** Supplemental Environmental Impact Statement (SEIS) is updating the FEIS analyses to include the disposal facility Waste Control Specialist, Inc. (WCS). The original FEIS decision excluded WCS since they were not a licensed facility at the time – *ongoing*

• Following completion of the SEIS, the Project’s Records of Decision will be amended
Preparing for Transportation

• Shipment information will be finalized following completion of NEPA analysis. Shipment information includes:
  – Communications Information
  – Emergency Planning/Notification/Response
  – Highway Routing
  – Rail Routing Interchange Points
Each filled uranium oxide cylinder weighs approximately 12 tons.
The project has 90 gondolas for transporting cylinders (40 cars/site with 10 reserve cars).
Each gondola railcar will contain up to 6 cylinders.
Transport ~3,000 Cylinders/year.
Each gondola will be covered with hard fiberglass covers.
Waste Control Specialists, LLC

Disposal facility’s low level radioactive waste cell located in West Texas

- Direct rail shipment to disposal facility
Low level radioactive waste cell located in Southern Nevada

- Requires a trans-load facility to truck in oxide cylinders.
  - Transfer cylinders from gondola railcars to truck for final delivery to NNSS
  - Due to gross weight of the uranium oxide filled cylinder, only one cylinder will be shipped per truck
Disposal facility’s low level radioactive waste cell located in Northwest Utah

- Direct rail shipment to disposal facility
The DUF₆ project plans to use standard commercial rail and truck shipment routes to transport converted oxide filled cylinders to the disposal facilities. Typical rail shipment routes may pass through the following states; depending on disposal site(s). Note: shipments to NNSS will consist of rail to a trans-load facility and trucked in to Nevada.

- Ohio
- Kentucky
- Tennessee
- Indiana
- Illinois
- Missouri
- Arkansas
- Kansas
- Nebraska
- Colorado
- Wyoming
- Utah
- Nevada
- Oklahoma
- Arizona
The DUF$_6$ project plans to use standard commercial rail and truck shipment routes to transport converted oxide filled cylinders to the disposal facilities. Typical truck shipment routes may pass through the following states; depending on disposal site(s):

- Ohio
- Kentucky
- Tennessee
- Indiana
- Illinois
- Missouri
- Arkansas
- Kansas
- Nebraska
- Colorado
- Wyoming
- Utah
- Nevada
- Oklahoma
- Arizona
Transportation/Disposal Challenges

- Nuclear Regulatory Commission’s decision regarding classification of large volumes of depleted uranium may affect shallow land burial cell requirements
  - Potential new waste classification for DU could require new/additional cell requirements
- Completion of Performance Assessments
- Resolution of moratorium imposed by the State of Utah on disposal of large scales of depleted uranium within the state
- Funding for Transportation and Disposal activities
Commercial DUF₆ Processing

- DOE has obligation from the USEC Privatization Act of 1995 to receive and process DUF₆ from any Nuclear Regulatory Commission licensed “uranium enrichment facility” if requested.
- The facility would reimburse the Government for costs of conversion, disposition and a share of the capital costs of the facilities.
- Several companies have sought DOE cost estimates for these services based on their projected DUF₆ production. The known commercial inventory quantity projections of DUF₆ are about the same as the initial DOE inventory.
- Current reimbursement rates are between $5.58 and $7.65 per kilogram.
- Converting this material would extend operations of the existing facilities beyond the several decades that will be needed for completion of converting the DOE inventory.
Questions?
Backup Slides
Initial inventory - approximately 800,000 total metric tons contained in ~66,500 steel cylinders
DUF₆ Project Overview

Process: Two nearly identical conversion plants at Paducah, Kentucky and Portsmouth, Ohio.

- Process uses dry conversion in a fluidized bed to convert DUF₆ into depleted uranium oxide and aqueous hydrofluoric acid (HF).
- HF recycled into industry.
- Depleted uranium oxide will be stored on-site and evaluated for beneficial reuse or disposal.

Status: Over 4,500 cylinders filled with uranium oxide stored at Portsmouth and Paducah (~1,900 at Portsmouth and ~2,600 at Paducah).
## Cumulative DUF₆ FY Results

### Conversion Totals

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>270 metric tons</td>
</tr>
<tr>
<td>2012</td>
<td>6,440 metric tons</td>
</tr>
<tr>
<td>2013</td>
<td>20,019 metric tons</td>
</tr>
<tr>
<td>2014</td>
<td>42,615 metric tons</td>
</tr>
<tr>
<td>2015</td>
<td>53,223 metric tons</td>
</tr>
<tr>
<td>2016</td>
<td>54,212 metric tons</td>
</tr>
<tr>
<td>2017</td>
<td>59,646 metric tons</td>
</tr>
</tbody>
</table>

### HF Shipped

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>22,000 gallons</td>
</tr>
<tr>
<td>2012</td>
<td>1,184,000 gallons</td>
</tr>
<tr>
<td>2013</td>
<td>3,456,000 gallons</td>
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<tr>
<td>2014</td>
<td>6,983,000 gallons</td>
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<tr>
<td>2015</td>
<td>8,578,000 gallons</td>
</tr>
<tr>
<td>2016</td>
<td>8,743,000 gallons</td>
</tr>
<tr>
<td>2017</td>
<td>9,605,000 gallons</td>
</tr>
</tbody>
</table>

Note: 59,646 MT DUF₆ converted = ~ 4,650 cylinders of oxide currently stored onsite
Emergency Response

• Transportation Emergency Preparedness Program (TEPP) is the DOE radiological training program for affected state, tribal and local emergency response units.
  

• DOE’s DUF6 Operations Contractor will maintain a 24-hour emergency response telephone number.

• Additional details will be provided in the transportation plan, which will be made available to the public following approval by DOE-HQ.